PROSPECTIVE ANALYSIS OF FUNCTIONAL OUTCOME OF COMPLETE ACROMIOCLAVICULAR JOINT DISLOCATION REPAIR USING DOUBLE ENDOBUTTON TECHNIQUE

Dissertation Submitted to

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M.S DEGREE IN

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DEPARTMENT OF ORTHOPAEDICS

TIRUNELVELI MEDICAL COLLEGE

THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY

CHENNAI, INDIA

APRIL 2016

CERTIFICATE

This is to certify that this dissertation entitled "**PROSPECTIVE ANALYSIS OF FUNCTIONAL OUTCOME OF COMPLETE ACROMIOCLAVICULAR JOINT DISLOCATION REPAIR USING DOUBLE ENDOBUTTON TECHNIQUE",** which is being submitted for M.S Orthopaedics, is a bonafide work of **Dr.P.MANIKANDAN**., Post graduate student of the Department of Orthopaedics, Tirunelveli Medical College Hospital, Tirunelveli, during the academic year 2014 -2016.

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He has completed the necessary period of stay in the department and has fulfilled the condition required for submission of this thesis according to university regulations. The study was undertaken by the candidate himself and the observations recorded have been periodically checked by us.

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DECLARATION

I, **Dr.P.MANIKANDAN**., solemnly declare that this dissertation tilted "**PROSPECTIVE ANALYSIS OF FUNCTIONAL OUTCOME OF COMPLETE ACROMIOCLAVICULAR JOINT DISLOCATION REPAIR USING DOUBLE ENDOBUTTON TECHNIQUE"** is a bonafide work done by me at Tirunelveli Medical College from July 2014 onwards under the guidance and supervision of **Prof. ELANGOVAN CHELLAPPA M.S.ORTHO, D.ORTHO**, Professor and Head of the Department, Department of Orthopaedics, Tirunelveli Medical College, Tirunelveli.

I have not submitted this dissertation to any other university for the award of any degree or diploma previously. This dissertation is submitted to The Tamilnadu Dr. M.G.R. Medical University, Chennai towards partial fulfillment of the rules and regulations for the award of **M.S Degree in ORTHOPAEDIC SURGERY (BRANCH – II)**

PLACE :

DATE : **Dr.P.MANIKANDAN**

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PROTOCOL TITLE: PROSPECTIVE ANALYSIS OF FUNCTIONAL OUTCOME OF COMPLETE ACROMIO CLAVICULAR JOINT DISLOCATION REPAIR USING DOUBLE ENDOBUTTON TECHNIQUE.

NAME OF PRINCIPAL INVESTIGATOR: Dr. P.MANIKANDAN, MBBS.,
DESIGNATION OF PRINCIPAL INVESTIGATOR: Post Graduate in MS Orthopaedics
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Dear Dr. P.Manikandan, *The Tirunelveli Medical College Institutional Ethics Committee (TIREC) reviewed and discussed your application during the IEC meeting held on 08.10.2014.*

THE FOLLOWING DOCUMENTS WERE REVIEWED AND APPROVED

1.	TIREC Application Form	☐
2.	Study Protocol	☐
3.	Department Research Committee Approval	☐
4.	Patient Information Document and Consent Form in English and Vernacular Language	☐
5.	Investigator's Brochure	☐
6.	Proposed Methods for Patient Accrual Proposed	☐
7.	Curriculum Vitae of the Principal Investigator	☐
8.	Insurance /Compensation Policy	☐
9.	Investigator's Agreement with Sponsor	☐
10.	Investigator's Undertaking	☐
11.	DCGI/DGFT approval	☐
12.	Clinical Trial Agreement (CTA)	☐
13.	Memorandum of Understanding (MOU)/Material Transfer Agreement (MTA)	☐
14.	Clinical Trials Registry-India (CTRI) Registration	☐

THE PROTOCOL IS APPROVED IN ITS PRESENTED FORM ON THE FOLLOWING CONDITIONS

1. The approval is valid for a period of 2 year/s or duration of project whichever is later
2. The date of commencement of study should be informed
3. A written request should be submitted 3weeks before for renewal / extension of the validity
4. An annual status report should be submitted.
5. The TIREC will monitor the study
6. At the time of PI's retirement/leaving the institute, the study responsibility should be transferred to a person cleared by HOD
7. The PI should report to TIREC within 7 days of the occurrence of the SAE. If the SAE is Death, the Bioethics Cell should receive the SAE reporting form within 24 hours of the occurrence.
8. In the events of any protocol amendments, TIREC must be informed and the amendments should be highlighted in clear terms as follows:
   a. The exact alteration/amendment should be specified and indicated where the amendment occurred in the original project. (Page no. Clause no. etc.)
   b. The PI must comment how proposed amendment will affect the ongoing trial. Alteration in the budgetary status, staff requirement should be clearly indicated and the revised budget form should be submitted.
   c. If the amendments require a change in the consent form, the copy of revised Consent Form should be submitted to Ethics Committee for approval. If the amendment demands a re-look at the toxicity or side effects to patients, the same should be documented.
   d. If there are any amendments in the trial design, these must be incorporated in the protocol, and other study documents. These revised documents should be submitted for approval of the IEC, only then can they be implemented.
   e. Approval for amendment changes must be obtained prior to implementation of changes.
   f. The amendment is unlikely to be approved by the IEC unless all the above information is provided.
   g. Any deviation/violation/waiver in the protocol must be informed.

STANDS APPROVED UNDER SEAL

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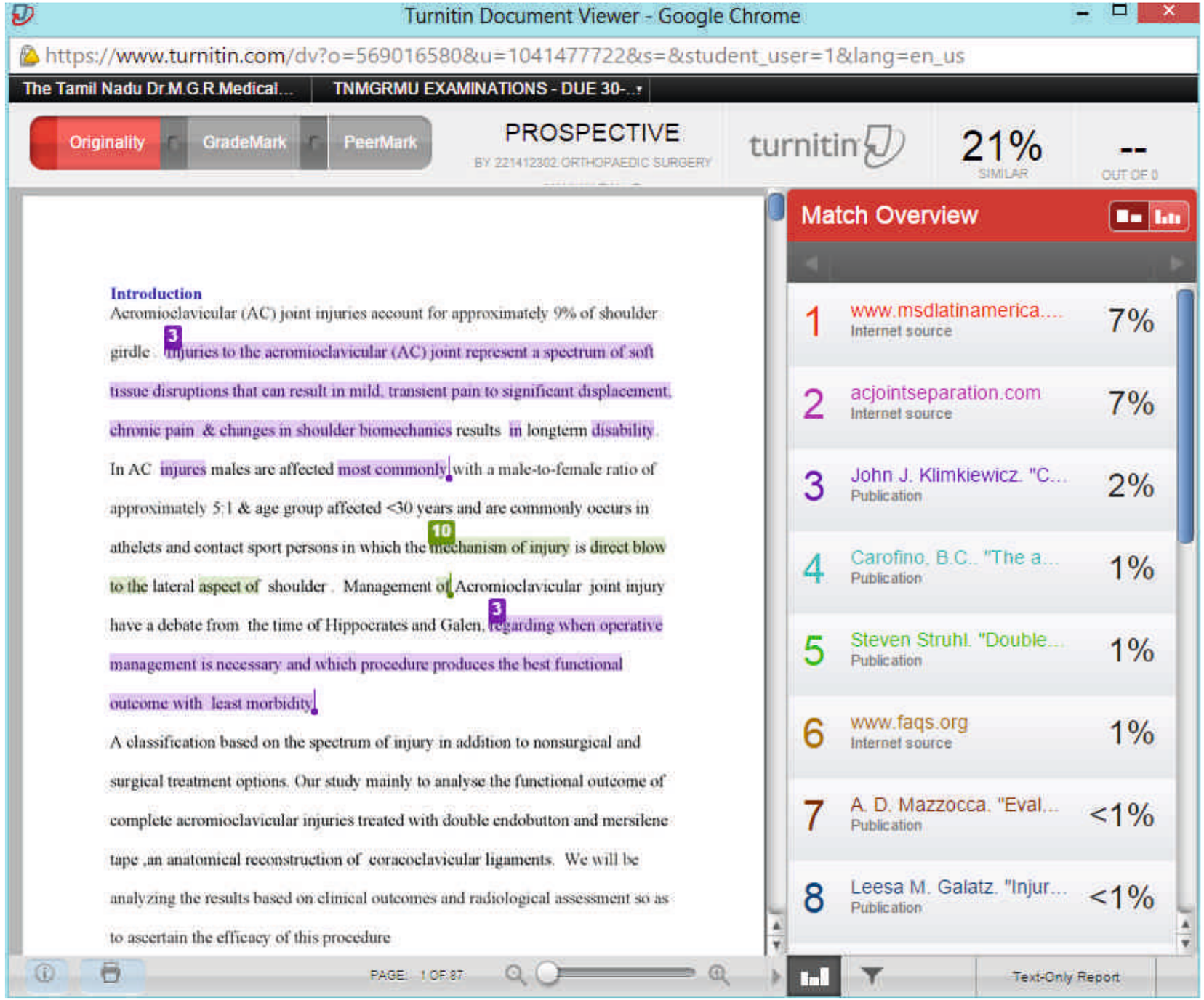


CONTENTS

INTRODUCTION

Acromioclavicular (AC) joint injuries account for approximately 9% of shoulder girdle. Injuries to the acromioclavicular (AC) joint represent a spectrum of soft tissue disruptions that can result in mild, transient pain to significant displacement, chronic pain & changes in shoulder biomechanics results in longterm disability. In AC injures males are affected most commonly with a male-to-female ratio of approximately 5:1 & age group affected <30 years and are commonly occurs in athletes and contact sport persons in which the mechanism of injury is direct blow to the lateral aspect of shoulder . Management of Acromioclavicular joint injury have a debate from the time of Hippocrates and Galen, regarding when operative management is necessary and which procedure produces the best functional outcome with least morbidity.

A classification based on the spectrum of injury in addition to nonsurgical and surgical treatment options. **Our study mainly to analyze the functional outcome of complete acromioclavicular injuries treated with double endobutton and mersilene tape, an anatomical reconstruction of coracoclavicular ligaments**. We will be analyzing the results based on clinical outcomes and radiological assessment so as to ascertain the efficacy of this procedure.

HISTORY

From a historical perspective, the treatment of AcromioClavicular joint dislocations has been a subject of controversy.

> "Galen1 (129–199 AD) had obviously paid close attention to Hippocrates, because he diagnosed his own AC dislocation received from wrestling in the Palaestra. This famous physician of the Greco-Roman period treated himself in the manner of Hippocrates (tight bandages to hold the projecting clavicle down while keeping the arm elevated)".

With our understanding of the local anatomy and the biomechanics of the joint, surgical treatment of AC joint injuries has evolved and demonstrates a clear historical progression.

Samuel Cooper is given credit for the surgical management of a displaced, painful AC joint dislocation in 1861.

" In 1917, Cadenat described transfer of the coracoacromial ligament, a procedure later popularized by Weaver and Dunn."

Over last 10 to 15 years there has been an increase in the number of publications of surgical treatment of AC joint dislocations with repairs or reconstruction procedures.

Rapid progression of orthopedic implant technology has also led to the application of improved surgical techniques and strategies. This has changed the way AC injuries are surgically managed.

Open reconstruction techniques have a common goal to reduce the AC joint to an anatomic position. This can be done using traditional methods that provide a rigid construct or a more anatomic approach, in which the goal is to provide a reconstruction that addresses the three-dimensional function of the AC joint complex.

ANATOMY

The Acromioclavicular joint, a diarthrodial joint, is formed between acromion and clavicle lateral end. Within the AC joint, there is a fibrocartilaginous disk of varying size and shape. In viewing from the anterior–posterior direction, AC joint inclination is almost vertical, or with the clavicle overriding the acromion by an angle as much as 50 degrees inclined downward and medially.

Acromioclavicular Ligaments

The AC ligaments, consisting of anterior, posterior, superior, and inferior ligaments, surround the AC joint. Among the capsular ligaments ,fibers of the superior Acromioclavicular ligament are the strongest, the deltoid and trapezius muscles blend with the fibers and are attached to the acromion process& the superior aspect of the clavicle. Stability of AC joint is improved by muscle attachments. Horizontal plane stability is given by these Ligaments.

Coracoclavicular Ligament

The CC ligament is a very strong, heavy ligament, fibers run from the base of coracoid process of the scapula to inferior surface of the clavicle. Conoid and Trapezoid ligaments are the two components of CC ligament.

The measurement of trapezoid ligament, by length 0.8 to 2.5 cm & width 0.8 to 2.5 cm . Length is 0.7 to 2.5 cm and width is 0.4 to 0.95 cm for conoid ligament. There is 10 mm distance from the lateral end of clavicle to lateral fibers of the trapezoid ligament.

The conoid ligament is cone shaped, apex of the cone attaching on the base of the coracoid process, posteromedial side aspect & base of the cone attaches onto the conoid tubercle of clavicle.

The trapezoid ligament attaches from coracoid process extends superiorly to the undersurface of the clavicle. It has the following relationship like , anterior and lateral to the attachment of the conoid ligament, posterior to the attachment of the pectoralis minor tendon.

Blood supply

Suprascapular and Thoracoacromial arteries supplies acromioclavicular joint

Nerve supply

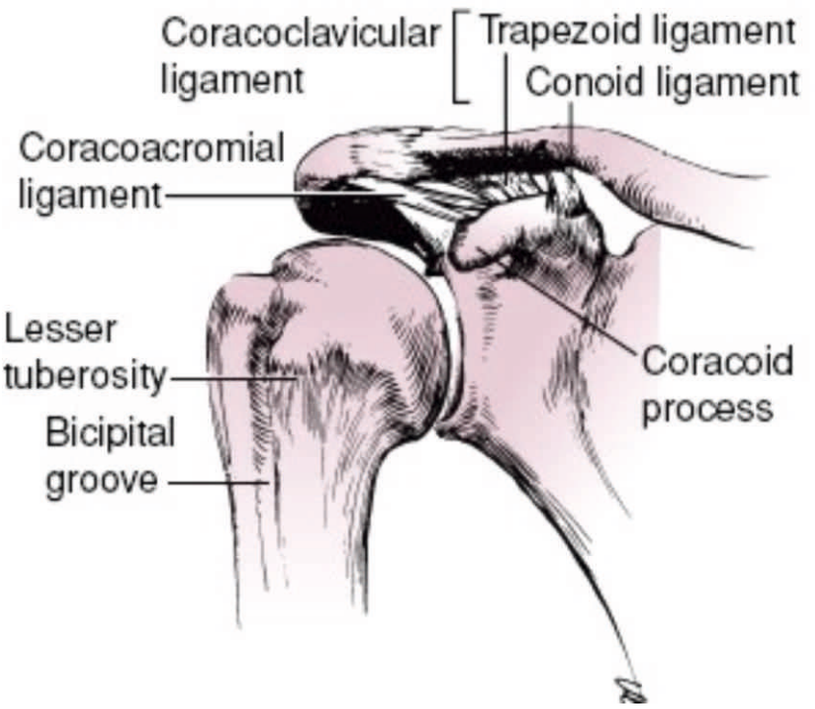
Branches from the suprascapular and lateral pectoral nerves supplies acromioclavicular joint .

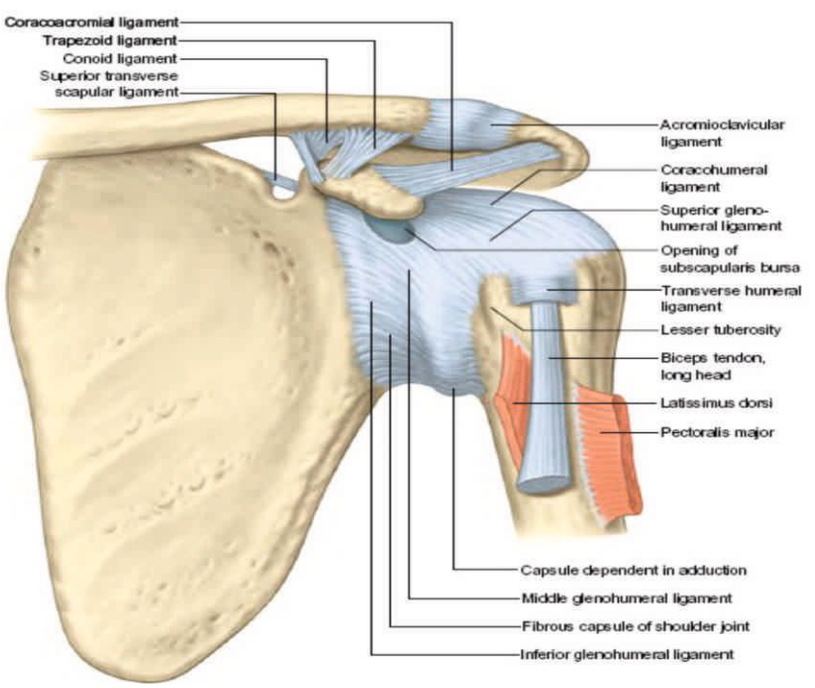
Movements

Only Passive movements occur at the joint because of no direct muscle action at the joint, but indirect movement from muscles acting on scapula.

There is 30° Axial rotation of the clavicle, in turn gives 60° scapular rotation when the two joints acting together.

ANATOMY AROUND ACROMIOCLAVICULAR JOINT





BIOMECHANICS

The AC joint biomechanics comprises of static & dynamic stability. Clavicles suspended away from the body by strong SC ligaments , like the wings from the body of an airplane in erect posture . The CC ligament support the upper extremities which are suspended from the distal clavicle. Thus, the prime suspensory ligament of upper extremity is CC ligament.

CC ligaments (conoid and trapezoid) and the AC capsule and ligaments gives AC joint stability predominantly. Only after the CC ligaments are transected, vertical displacement of the clavicle occurs .

Fukuda et al. performed load-displacement tests that concludes , At small displacements, the posterior (89%) and superior (68%) translation of the clavicle restricted by AC ligaments. At large displacements , the primary restraint (62%) for superior translation is, the conoid ligament, the primary restraint (90%) for posterior translation is AC ligaments.

At both large and small displacements, the primary restraint for compression of AC joint is the trapezoid ligament.

These experiments have led to the following conclusions regarding the AC joint “the AC ligament and capsule gives the horizontal stability&
CC ligaments gives the vertical stability “

Motion - Acromioclavicular Joint

With elevation of the shoulder, the clavicle rotates 40 to 50 degrees superiorly, this rotation is combined with simultaneous scapular rotation.

Rockwood et al. showed that there was only 5 to 8 degrees of rotation of the clavicle in relation to acromion. . Codman described this as“synchronous scapuloclavicular motion ’’

MECHANISM OF INJURY

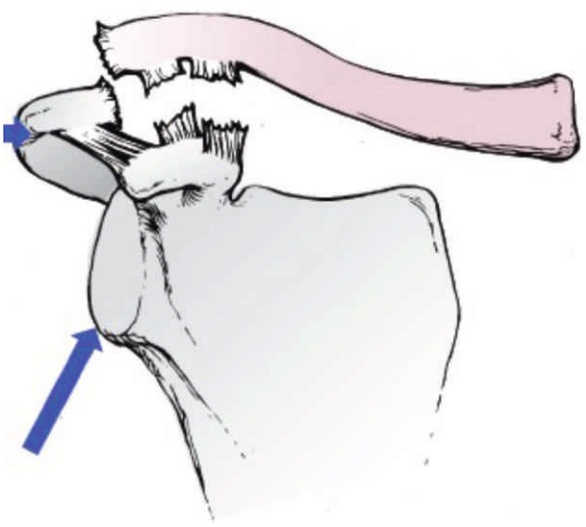
The direction and magnitude of the force vector leads to the resultant injury pattern. Falling on an outstretched arm, locked in extension at the elbow, can lead the humeral head superior into the acromion typically resulting in low-grade AC joint injuries . A medial directed force to the lateral shoulder that drives the acromion into and underneath the distal clavicle, can result in higher degrees of injury and subsequently more displacement.

One of the more common mechanism is direct force involves falling or being tackled onto the lateral aspect of the shoulder with the arm in an adducted position which produces a compressive (medial) and shear (vertical) force across the joint.

The injury force which drives the acromion medially and downward produces a progressive injury pattern; disruption of the AC ligaments, followed by CC ligaments, and finally disruption of the fascia overlying the clavicle that connects the deltoid and trapezius muscle attachments. At this point, the upper extremity has lost its suspensory support from the clavicle and the scapula and associated glenohumeral articulation displaces inferiorly secondary to forces of gravity. Although there may be an upward displacement of the clavicle from the pull of the trapezius muscle, the characteristic anatomic feature is actually inferior displacement of the shoulder and arm. The mechanism of inferior dislocation of the

clavicle under the coracoid is thought to be a very severe direct force onto the superior surface of the distal clavicle; along with abduction of the arm and retraction of the scapula, this type of AC joint dislocation is exceedingly rare.

MECHANISM OF INJURY

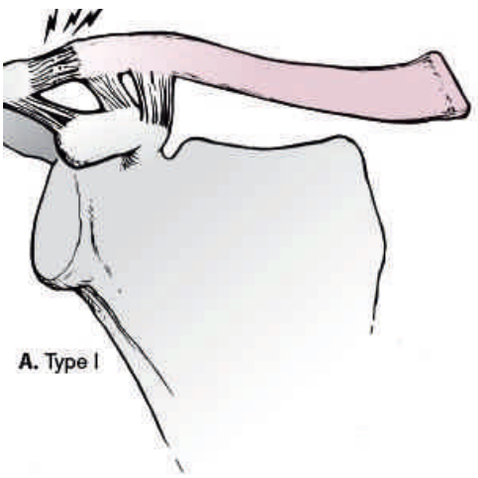


VECTOR OF FORCE

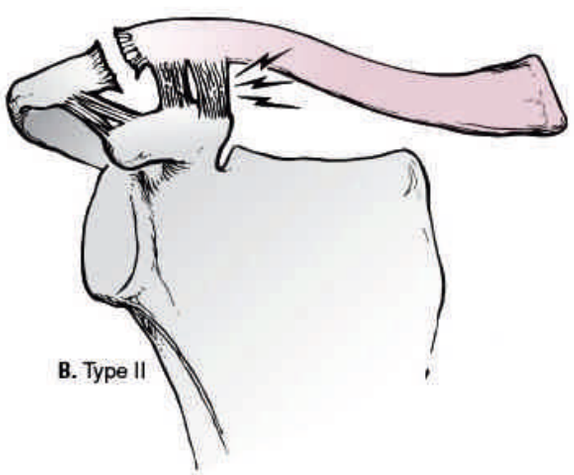
CLASSIFICATION

The classification of AC joint injuries is based on the force induced injury. The grading of AC joint injuries is dependent on the amount of injury to AC and CC ligaments. The work of Tossy et al. is the basis of Rockwood et al's classification, which is the widely accepted classification. The anatomic severity of the injury forms the basis of this accurate system of classification. There is disruption of AC ligaments in both subacromian as well as subcoracoid dislocation, but, CC ligament stays intact in subacromial dislocation whereas there is complete disruption in subcoracoid dislocation. The same way the degree of clavicular displacement decides the integrity of both deltoid and trapezius.

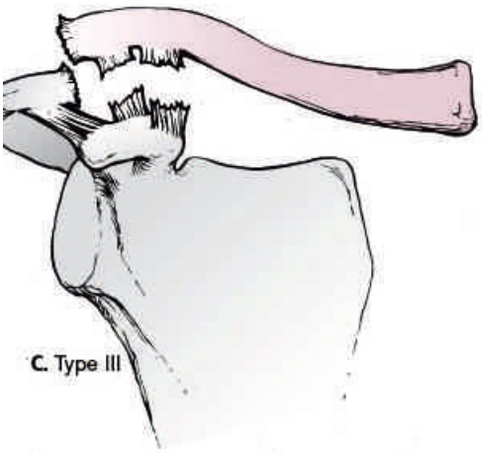
ROCKWOOD AND GREEN CLASSIFICATION



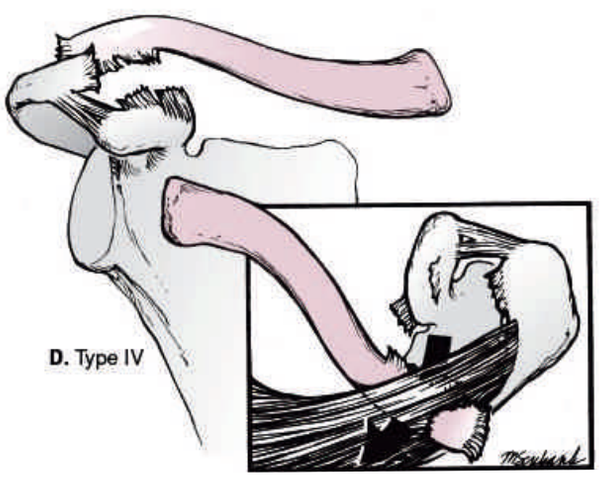
Type I A mild force to the point of the shoulder produces a minor strain to the fibers of the AC ligaments. The ligaments remain intact, and the AC joint remains stable.



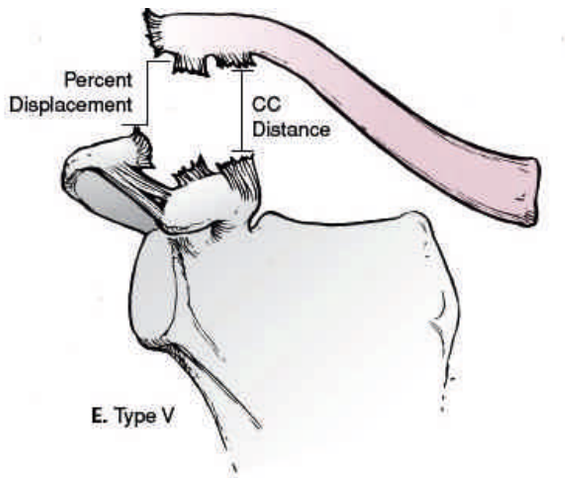
Type II A moderate force to the point of the shoulder is severe enough to rupture the ligaments of the AC joint. The distal end of the clavicle is unstable in the horizontal plane (i.e., anteroposterior), but vertical (i.e., superoinferior) stability is preserved by virtue of the (damaged but) intact coracoclavicular ligament. The scapula may rotate medially, producing a widening of the AC joint.



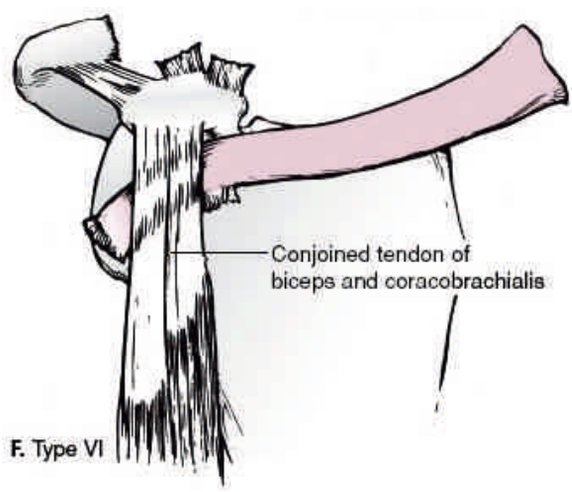
Type III A severe force is applied to the point of the shoulder which tears the AC and coracoclavicular ligaments resulting in a complete AC dislocation. The distal clavicle appears to be displaced superiorly as the scapula and shoulder complex droop inferomedially. Radiographic findings include a 25–100% increase in the coracoclavicular space in comparison to the normal shoulder.



Type IV Posterior dislocation of the distal end of the clavicle, or a type IV AC dislocation, is relatively rare. The clavicle is posteriorly displaced into or through the trapezius muscle as the force applied to the acromion drives the scapula anteriorly and inferiorly. Posterior clavicular displacement may be so severe that the skin on the posterior aspect of the shoulder becomes tented.



Type V AC dislocation is a markedly more severe version of the type II injury. The distal clavicle has been stripped of all its soft tissue attachments (i.e., AC ligaments, coracoclavicular ligament, and the deltotrapezial muscle attachments) and lies subcutaneously. When combined with superior displacement of the clavicle owing to unopposed pull of the sternocleidomastoid muscle, the severe downward droop of the extremity produces a marked disfiguration of the shoulder. Radiographically, the coracoclavicular space is increased greater than 100% in comparison to the opposite, normal shoulder.



Type VI Inferior dislocation of the distal clavicle, is an exceedingly rare injury. The injury is often the result of severe trauma and is frequently accompanied by multiple injuries. The mechanism of dislocation is severe hyperabduction and external rotation of the arm, combined with retraction of the scapula. The distal clavicle occupies either a subacromial or a subcoracoid location.

Patte's classification:

Grade	Denomination	Coracoclavicular distance	Facet deviation	Rockwood type
I	Simple sprain	Normal	Non	I
II	Acromioclavicular dislocation	Normal	Subluxation	II
III	Scapuloclavicular dislocation	> 50% increase	Subluxation/dislocation	III
IV	Irreducible scapuloclavicular dislocation	> 50% increase	Mainly posterior	IV
V			Mainly superior	V
VI	Inferior dislocation	Negative		VI

IMAGING

Anteroposterior Views

For routine AP views the patient should be standing or sitting, with their arms hanging at the side, unopposed and resting the back against the X-ray cassette, both AC joints should be imaged simultaneously. The difficulty in evaluating AC joint injuries is the superimposition of the scapular spine on the distal clavicle and the acromian. Subtle distal clavicular fractures are easily missed. Zanca proposed a cephalic tilt view of 10 to 15 degrees to form a clear image of the joint **.** This cephalic tilt standardizes the distance between clavicle & coracoid which apparently increases with more AP view. This is the routine view used to evaluate AC joint injuries and is of particularly use when a small fracture is suspected and stress view showing both shoulder AP also improves the diagnosing possibility of AC joint injuries.

Axillary Lateral View

In shoulder injury, if there is suspicion of AC dislocation an Axillary lateral view is a must. On the superior aspect and medial enough, the cassette is placed for maximum exposure of the lateral one third of the clavicle. This view reveals the posterior displacement of clavicle and the small fractures within coracoid.

Stryker Notch View

In Stryker notch view the coracoids is in profile and for evaluating injury it is the best view. For this the patient lies supine with the arm elevated over the head with the palm behind the head. The humerus must be parallel to the longitudinal axis of the body, with the elbow pointed straight toward the ceiling. This can be a difficult view to obtain in the acutely injured shoulder

Normal Joints

The AC joint is 1to 3 mm wide in the coronal plane. There is diminision of AC joint space as the age advances; if the joint space is 0.5 mm in a patient over 60 years, it is normal; if the joint space is greater than 7 mm in men & 6 mm in women, it is pathologic. There is significant variation in the CC interspace individual wise. On an average the clavicle and the coracoids are 1.1 to 1.3 cm away. The AC dislocation is complete if the CC distance increases by 50% over the normal side. The CC distance increases a little about 25% in complete AC dislocation.

ZANCA VIEW

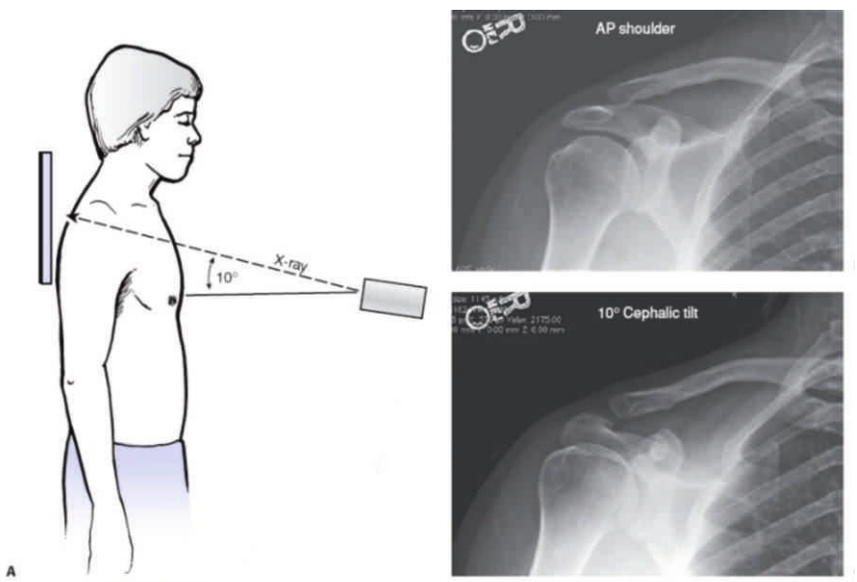


FIGURE 41-12 **A:** Illustration of the "Zanca view" which is shot with the x-ray beam placed 10 degrees cephalad to the perpendicular plane. **B:** Radiograph of shoulder perpendicular to floor. **C:** Radiograph done with Zanca view—10-degree cephalad tilt to demonstrate the effect of the view

STRYKER NOTCH VIEW

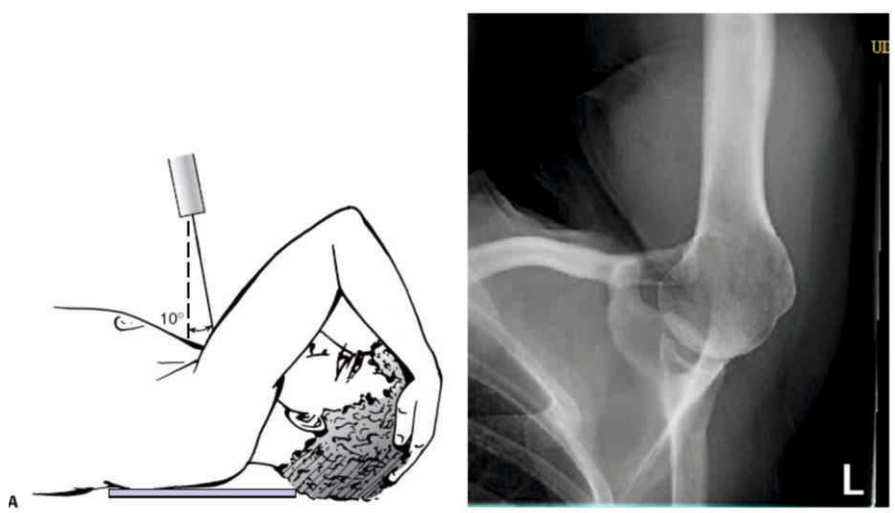


FIGURE 41-13 **A:** Illustration of positioning for the Stryker notch view. **B:** Stryker notch view radiograph of a patient. Note the view of the coracoid base where a fracture could be visualized.

TREATMENT

NONOPERATIVE TREATMENT

There is a general consensus supporting nonoperative treatment of Rockwood type I and type II AC joint injuries. Both type I and type II AC joint injuries are treated in the acute setting with an initial period of immobilization. Although both type I and type II AC injuries are on the lower end of the spectrum ,both types may remain symptomatic several years following injury. These lower grade AC joint injuries remain symptomatic for variety of reasons, such as posttraumatic arthritis, osteolysis of clavicle posttraumatically, recurrent AP subluxation, capsular ligament tear which gets trapped within the joint, loose pieces of articular cartilage, intra-articular meniscus detachment. In contradistinction to type I and type II AC joint injuries, greater controversy exists regarding the optimal treatment of type III AC joint injuries, due to the difficulty in differentiating type III from type V injuries of the AC joint. Type III AC joint injuries have a completely torn AC and CC ligaments with 25% to 100% superior displacement in comparison to the contralateral shoulder. Type V AC joint injuries have, complete tears of the AC and CC ligaments, stripping of deltotrapezial fascia results in greater than 100% superior displacement compared to the contralateral shoulder. During the 1930s to 1940s, conservative treatment of type III AC joint injuries was predominant.

During the 1950s to 1970s, with advances in surgical technique, operative repair became the mainstay for managing these dislocated AC injuries. In the early 1990s,Cox et al.36 polled two groups of orthopedist—one group of specialized sports medicine orthopedists and a second group of chairmen of orthopaedic residency programs. Both groups preferred nonoperative management of type III AC joint injuries at 86.4% in the sports medicine specialist group and 72.2% in the orthopedic residency programs. Recently, in 2007, Nissen and Chatterjee112 polled, who are the members of the American Orthopaedic Society for Sports Medicine (AOSSM) and residency directors of orthopedic surgery programs who together had inclination toward nonoperative treatment of type III AC injuries. In light of higher levels of evidence, there are two studies of nonoperative versus operative treatment for AC injuries which are prospective randomized studies.

In a prospective randomized study, Bannister et al. had patients treated operatively with reduction and fixation by a CC screw or nonoperative treatment for two weeks with a broad arm sling followed by the same rehabilitation as the operative group. After 4 years of follow-up, the nonoperatively treated group demonstrated quicker regain of movement, quicker return to work and sports, and fewer poor results. However, subgroup analysis of AC dislocations with >2 cm of displacement showed better results in the operatively treated group.

Larsen et al. had patients randomized to nonoperative treatment with a sling or operative treatment using the Phemister procedure where theAC joint is reduced and fixed with two threaded 2-mm Kirschner wires crossing the joint space followed by suturing of the AC ligament, CC ligament, and surrounding muscle ruptures. From this study, the nonoperatively treated group demonstrated shorter rehabilitation time and the operatively treated group demonstrated higher amount of complications with about half of the operatively treated patients having problems with the metallic device or superficial infections.

In comparison between the operative and nonoperative groups, there was no difference in clinical results. Polytrauma patients with AC joint injuries are given more profound consideration toward operative management.

Gallay et al., report showed an AC joint injury, in a patient who suffered polyutrauma, has greater ramifications with regard to shoulder function as assessed by disease specific and general health outcomes.

The type IV, V, and VI AC joint injuries, with attention to the soft tissue disruption and persistently dislocated joint, are generally treated operatively.

The nonoperative treatment of AC injuries consists of an immobilization device and so-called skillful neglect. Immobilization devices consisted of many variations including slings, adhesive tape strappings, braces, harnesses, traction techniques, and plaster casts. Among these immobilization devices, the sling is an

applied method of conservative treatment. the principle behind the immobilization device is to support the weight of the upper extremity with the intention of reducing the stress placed upon the ligaments of the joint. Briefly, during the first week of treatment, the immobilization device, together with ice and analgesics, help reduce the pain and inflammation as a result of the AC joint injury. The amount of injury to the AC joint complex and gradation of dislocation does not change from the time of injury. the goal of acute phase management is pain control.

Following the initial period of immobilization, 1 to 2 weeks depending on grade of dislocation, strengthening exercises are commenced with particular focus on periscapular muscles that are important to shoulder biomechanics. both heavy lifting and contact sports are avoided during the second phase of treatment with strengthening exercises.

Gladstone and colleagues (11) described a four-phase rehabilitation program:

Phase 1, pain control and immediate protected range of motion and isometric exercises;

Phase2, strengthening exercises using isotonic contractions and proprioceptive neuromuscular facilitation exercises;

Phase 3, unrestricted functional participation with the goal of increasing strength, power, endurance, and neuromuscular control;

Phase 4, return to activity with sport-specific functional drills.

Most patients are able to return to normal activity in 2 to 4 weeks.

An athlete is ready to return to competitive sports once the following criteria are met:

1. Full range of motion, no pain or tenderness,
2. Satisfactory clinical examination, and
3. Demonstration of adequate strength on isokinetic testing

Most athletes are able to return to play in 2 to 4 weeks but other authors reported that some require up to 12 weeks (2)

Several studies have compared nonoperative treatment to operative treatment of AC injuries. In one of the earlier comparison studies, Galpin et al. compared operative treatment, by a Bosworth CC screw, with nonoperative treatment of complete AC dislocations. The results of this study reported equal, if not superior, results in the nonoperatively treated group with regard to earlier return to activities, sports, and work. In both groups, despite the treatment, range of motion and strength were found to be equal.

In a more recent study, Gstettner et al. retrospectively reviewed patients with AC joint injury, grade III who were treated with a hook plate surgically in comparison to those treated conservatively at a mean follow-up of 34 months. Improved Constant Scores were found in the surgically treated group.

Calvo et al.reported no significant difference in results between operative and nonoperative treatment of type III AC joint injury. In particular, the operatively treated AC injuries showed a significantly higher incidence of osteoarthritis and CC ligament ossification.

Press et al. found that both operative and nonoperative treatment are beneficial, but with nonoperative treatment patient returs early to work and sports. When the range of motion of shoulder joint, muscle strength, and neurovascular findings were compared between the two groups, no significant differences were found.

Goss (5) defined “the concept of the superior shoulder suspensory complex”. The ring is formed by bony superior glenoid, the coracoid process, the distal clavicle, the acromion and soft tissue component of acromioclavicular joint and its ligaments, the coracoclavicular ligaments.

It is likened to the pelvic ring wherein damage to one part of the superior shoulder suspensory complex must also produce disruption of another portion of the osteoligamentous ring, leading to the so-called ‘double disruptions.

Therefore all type-III to type-VI dislocations fall within this category, since both the acromioclavicular and coracoclavicular ligaments are injured. Dislocations which occur together with fracture of another component of the complex such as the lateral clavicle or coracoid process are also double disruptions. These types of injuries are unstable and may result in adverse long term effects of healing and function. He suggested that these injuries should be considered for operative reduction and stabilization of at least one component of the disruption.

OPERATIVE TREATMENT

Indications/Contraindication

It should be noted that altered shoulder biomechanics secondary to complete AC joint displacement was shown in a recent study of patients with type III injuries to result in scapular dyskinesis and, eventually,(SICK scapula syndrome (scapular malposition, inferior medial border prominence, coracoid pain and malposition, and dyskinesis of scapular movement). This condition developed in 54% of patients with chronic type III AC dislocations . Overall, operative treatment is generally the accepted method for active healthy patients with complete AC joint injuries (types IV, V, and VI) because of the significant morbidity associated with the injury pattern that can lead to a persistently dislocated, unstable AC joint, with a change in scapular kinematics, and shoulder dysfunction.

Surgical Procedure—Historical/Classic Techniques

Earliest reports of AC joint repair were attributed to **Samuel Cooper** in the year 1861 by using a silver wire .

In the late 19th century, he was followed by **Poirier, Rieffel, Tuffier, Baum** who used sutures to repair the AC ligaments and the joint capsule .

Paci in the year 1889 advocated arthrodesis of the AC joint. **Budinger** used a screw while **Lambotte and Delbet** used a nail for AC joint fixation .

Morestin was the first to resect out the lateral 2.5 cms of the clavicle .

Delbet is credited for the first attempts of reconstructing CC ligaments initially using a silver wire and later a silk suture.

Cadenat (10) is attributed to the usage of a strip of tendon of short head biceps to reconstruct the CC ligaments but later found anterior displacement of clavicle due to its anterior transposition. In 1917, he was reported to have used the coracoacromial ligament to reconstruct the CC ligament because of the insertion of the coracoacromial attachment onto the coracoid (it being more posterior than biceps tendon and near the origin of CC ligament) and secondly to the fact that harvesting anterior part of this ligament sufficed in length for the repair.

Bunnel in 1928 used a fascia lata to reconstruct the AC joint.

Henry in 1929 used autogenous fascia lata with addition of 2 Kirschner wires.

In the decade between 1930 -1940 there was a resurgence of nonoperative treatment modalities for the then Tossy type III.

The surgical options began to develop with growing interest in this type due to the growing conflict of non operative treatment.

Murray recommended smooth Kirschner wires while **Bloom** recommended two 1/32- inch Steinman pins

Excision of the distal 1/3 of clavicle was described by **Mumford and Gurd** in 1941 but the earliest literature suggests **Morestin** as the first person to do this procedure as early as the late 19th century.

Bosworth in 1941was the first to describe a screw inserted from the clavicle into the coracoid and thereby functioning similar to the CC ligament.

Phemister in 1942 reported the use of heavy threaded pins across the AC joint (5).

Stewart described the usage of a screw to fix the AC joint

Caldwell in his 1943 paper, stated that he preferred arthrodesis of the AC joint as a treatment option (16).

Weaver-Dunn in 1972 reported their results of transfer of coracoacromial ligament to lateral end of clavicle after when clavicle's lateral end is excised .

In 1964, **Bailey** presented coracoid process along with the conjoined Tendon transferred to the clavicle.

Dewar and Barrington, 1965, presented their modified version of Bailey procedure .

Balser(in the mid 1980s) presented a new concept on the uses of a hook plate and later **Wolter** (late 1980s) presented his modification of the hook plate.

Bateman (12) attempted reconstruction of CC ligament by creating a new suspensory ligament out of fascia lata. Intra-operatively, if the AC joint was found degenerative then, excision of the lateral end of clavicle was advised.

Neviaser (12) detached the coracoacromial ligament from the coracoid and swung it on top of the distal end of clavicle thereby reconstructing a new superior AC ligament. He did not believe that the CC ligament needed to be repaired and has shown results

EXTRA-ARTICULAR CORACOCLAVICULAR REPAIRS

They can be divided into:

1. Coracoclavicular ligament repair, fixation or reconstruction
2. Dynamic muscle transfers
3. Excision of the lateral end of clavicle

CORACOCLAVICULAR LIGAMENT REPAIR AND RECONSTRUCTION

In 1917, **Cadenat** (10) transferred the coracoacromial ligament from its coracoids attachment and inserted it to the conoid insertion, the periosteum at the posterosuperior part of clavicle and finally onto the aponeurosis of the trapezius attachment.

Campos (10) had his modification consisting of disinserting the acromial end and transfixing it to the clavicle's lateral end by making a hole.

Harrison & Sisler used a Dacron tube circling coracoid and a hole in the clavicle.

Phemister did an ORIF of the AC joint using a 2 ply stainless steel wire which ran from the acromion to clavicle's lateral end

Bundens and Cook added to Phemister procedure by imbricating the deltoid and trapezius muscles over the clavicle to help stabilize the clavicle.

Weinstein et al used a No.5 non absorbable suture as their modification of Phemister to avoid the wire break out seen with Phemister procedure.

Tauber M et al and **Gonzalez** et al have developed the use of autogenous semitendinosis and peroneus brevis grafts respectively. At present gracilis tendon, toe extensors are also being used.

Chen et al used Marsilene prosthetic substitute to reconstruct the CC ligament Dacron or velour Dacron graft has been used by many surgeons like

Goldberg, Kappakas, Tagliabue and Riva, Dahl and they have found good results especially with double velour Dacron graft .

Polydioxanone (5) graft has been described for successfully usage by **Hawkins et al, Krueger-Franke M et al, Morrison DS, Lemos MJ et al, Nicholas SJ et al.**

Wellmann et al (24) have used 2 flip buttons to anchor the lateral end of clavicle to coracoid. In their study they used 12 fresh frozen cadaveric shoulders, the AC ligament and CC ligaments reconstructions were tested. They initially severed the coracoacromial ligament off the acromion and then inserted it into the lateral end of clavicle and further reinforced with two No.5 Ethibond suture and tested its stability. For the augmentation, 1mm Ethibond is intertwined between 2 flip buttons, one button is passed through a predrilled hole into the base of coracoid and another button into the clavicle at a distance of 35mm from AC joint. Then he medial half of coracoclavicular ligament is released and inserted into a predrilled clavicle at 20mm from the AC joint. The results showed that an augmented CAL transfer can restore the intact acromioclavicular joint kinematics whereas the selective coracoclavicular ligament transfer cannot.

Lee evaluated the biomechanical properties of the CC ligament repair, Weaver-Dunn procedure, combinations using autogenous tendons and synthetic

tapes and sutures in cadavers. He found that simple CC ligament repair was weak and had the worst failure load .

Tienen combined the “open Weaver-Dunn procedure” with AC ligament repair with Poly Diaxon and showed good results

LaFosse did a “modified Weaver-Dunn procedure” arthroscopically with fire-wire braids initially stitched thorough the substance of CA ligament and then proceeded to disinsert it by burring and finally attaching it to the clavicle thorough a predrilled hole and securing it with metal wires. The results were comparable to the open procedure but with less incidence of infection, keloids and implant failure.

CORACOCLAVICULAR FIXATION

Bosworth described his technique of coracoclavicular fixation in the year 1941 by using a tapered large flat head lag screw which he passed into the coracoid from clavicle superiorly. He did not explore nor repair the CC ligament (10).

Kennedy and Cameron in 1954 modified Bosworth procedure by doing a thorough debridement of AC joint, over correcting the AC joint dislocation with a Bosworth lag screw and finally repair the deltoid and trapezius tear. They believed that the screw will produce an ossification of the CC ligament and

thereby create an extra-articular arthrodesis of AC joint. Weitzman had a similar modification of Bosworth as by Kennedy and Cameron but differed by debriding the AC joint and imbricating the deltoid and trapezius (27).

Jay and Monnet added to the Weitzman modification by repairing the CC ligament.

Tsou inserted a cannulated cancellous screw percutenously has associated complication rates .

Tanner and Hardegger used a 6.5-mm screw .

Bateman in a prospective study of 60 patients randomly treated operatively (Bosworth method) and nonoperatively. In the nonsurgical group 4 patients did not respond to this method of treatment and surgery was done for pain and weakness while 45 of the operated patients developed reduction failure and failure of hardware. They thus concluded that non operative treated was superior .

Bancha Chernchujit (28) et al operated 32 patients with AC joint disruptions arthroscopicaly using anchor suture to create a synthetic CC ligament. They had no wound complications, free mobility was seen in 12 patients and cosmetic scars were seen in all patients. 10 patients revealed anatomical reduction, 2 patients had a small (2-4mm) loss of reduction and one with complete dislocation. Patient satisfaction was 92% and Constant score averaged 95.

DYNAMIC MUSCLE TRANSFERS

Bailey in 1964 was the first to do a transfer of the coracoid process with the conjoined tendons and showed favorable results .

Later in 1965, **Dewar and Barrington** did an addition to the Bailey procedure by using a segment of the detached pectoralis minor tendon .

Baumgarten et al., Lafosse L et al and Vargas L et al. have studied the use of conjoined tendon to the superior aspect of clavicle as a 'dynamic muscle transfer'. They also described modifications to the same by osteotomizing the coracoids insertion with the tendon. They have found this method of conjoined tendon graft transfer has better properties and greater consistency of quality of the graft as compared with those of the coracoacromial ligament. Variations of this procedure, by splitting the lateral half of the conjoined tendon as a distal based, thereby retaining the original coracoid attachment .

LATERAL END OF CLAVICLE EXCISION

Mumford and Gurd, 1941 independently described a surgical procedure for chronic symptomatic subluxed or dislocated AC joints with arthritic changes. They resected the clavicle lateral to the CC ligaments and Mumford repaired the CC ligament.

Weaver and Dunn in 1972 added to the Mumford and Gurd procedure by transferring the coracoacromial ligament to the intramedullary canal of the clavicle (tendon transfer alone was done by Cadenat in 1917) .

Powers and Bach compared 47 patients with Tossy III type of injuries comprising of 28 nonoperative (20 treated with a body arm cast and 8 in a sling) and 19 operated (14 had AC joint fixation with wires, 4 with lateral end of clavicle excision and 1 with ligamental repair with fascia). Out of the 28 not operated only 4 had fair results and the rest were good. Among the operated 9 had good results,2 fair results and 3 poor results from which they concluded that nonoperative patients had a better result .

Various authors have modified this procedure coracoclavicular fixation with heavy nonabsorbable suture, surgical tape, screw, Double-Button with PDS suture material (6), tendon grafts.

This procedure though done open initially is now also done arthroscopically The surgical treatment for AC joint dislocations has a clear historical progression. Superior clavicle plates with lateral hooks or “AC hook plates” have been reported in the literature since the 1980s with mixed results. There have been a few modifications to the plate by lower its profile or add “locking screw technology” but the concept remains same. This type of fixation holds CC distance in a

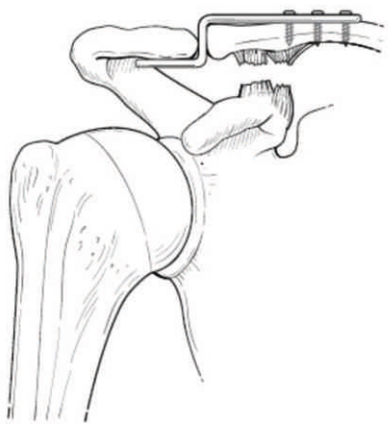
reduced position by “hooking” under the acromion elevating the glenohumeral joint . Most reported case involving superior clavicle “hook” plates are used in patients with chronic dislocations often with concomitant AC joint arthrosis. Rates of good or excellent results ranging between 60% and 94% have been reported, but complications of this technique include acromial fracture or erosion and hardware irritation necessitating removal of the plate.

More importantly, the pain was worse with hook plate group than plate and everyone needed surgical removal. Persistent pain syndrome due to chronic irritation of subacromial space and plate removal or sustained acromialosteolysis and fractures are the other complications related to hook plates,. In the study reported by Kienast et al. there was an overall complication rate of 10.6% with a 2% redislocation rate. A similar study reported a 12% redislocation rate.

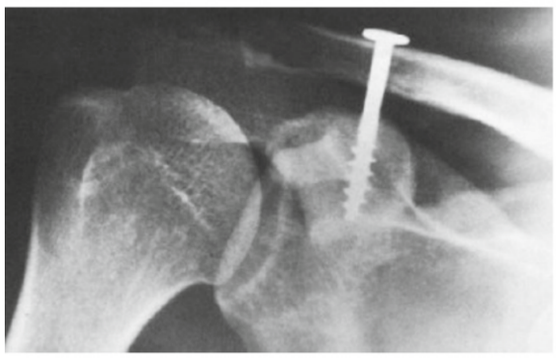
Anatomic Approaches

The first attempt at the reconstruction of the CC ligaments was reported in 1942 by Vargus, describing transfer of part of the conjoined tendon anterior to the clavicle. “Anatomic reconstruction” of native CC and AC ligaments represents an improved understanding of the biomechanics in this area with the possibility of improved surgical outcomes. The “anatomic coracoclavicular ligament reconstruction (ACCR)” technique is for the restoration of AC joint biomechanics for the treatment of painful or unstable dislocations.

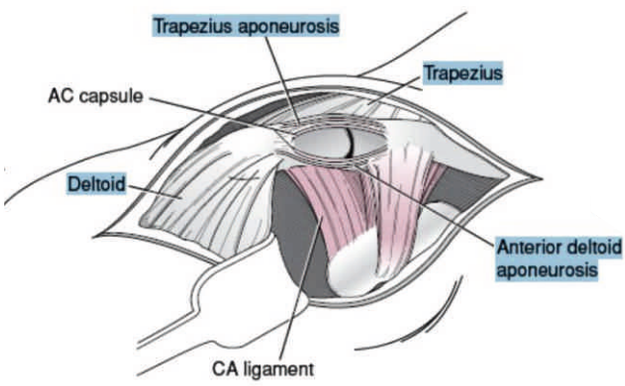
HOOK PLATE FIXATION

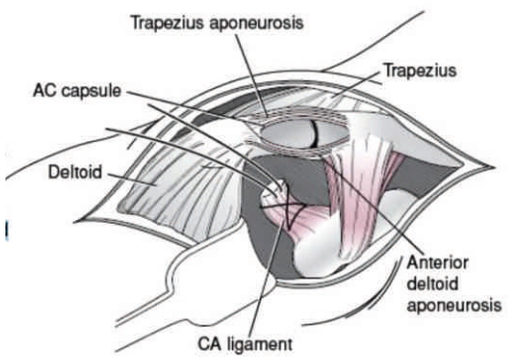


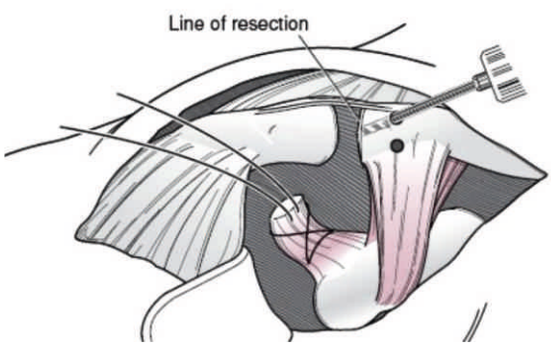
BOSWORTH SCREW FIXATION

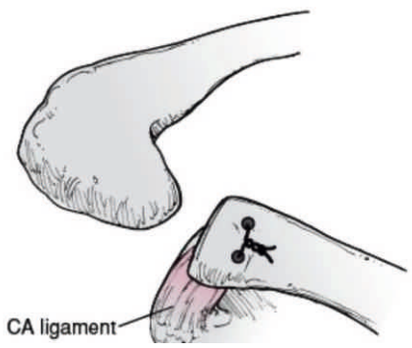


WEAVER-DUNN PROCEDURE









Patient Positioning

The procedure is performed in the beach-chair position with hip flexed to 60 to 70 degrees, and the patient positioned far lateral on the operating table to allow the arm to fall into extension. This facilitates exposure and mobilization of the shoulder for scapula reduction to the clavicle. A small towel bump placed interscapular region to prevent protraction of the scapula.

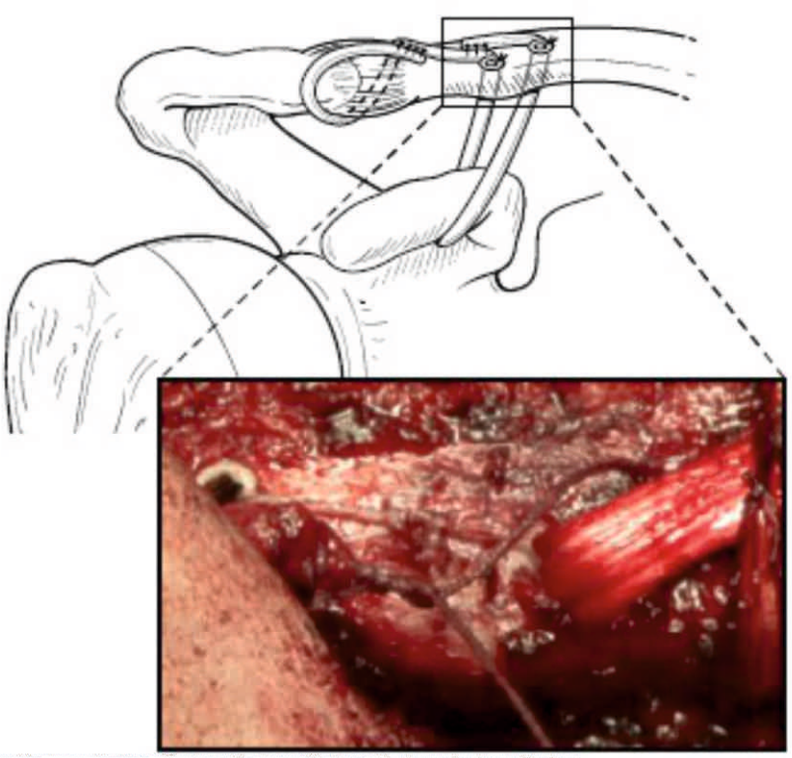
In addition, this elevates trunk away from the table and improving access to the clavicle for drilling the bone tunnels. Gently rotating the patient head away from the operative field with extension aids in exposure

. The patient is secured with a safety belt and 3-in cloth tape around the chest. It is important to drape a wide operative field- from the SC joint, to the nipple line, up the neck to the base of the ear, and extends several inches behind the posterior aspect of clavicle. Before prepping, C-arm is prepositioned to allow imaging intraoperatively. Comparative Zanca view is made of the normal AC joint to act as a reference for the measurement of the intact CC distance.

BEACH CHAIR POSITION

SURFACE MARKING

FIXATION



Management of Expected Adverse Outcomes and Unexpected Complications in Acromioclavicular Joint Injuries

When the applied force is inferior and medial to the dorsum of the acromian mostly ariculation of AC joint, ariculation of SC joint, or clavicular shaft is injured. Also, combined injuries are also reported. “Wurtz et al.166 and Lancourt” have reported combination of AC dislocation and clavicle fracture.

Simultaneous dislocations where both the SC and AC ends of the clavicle also known as “bipolar” dislocations are reported by many.

During injury, mostly a posterior / type IV AC dislocation is associated with an anterior SC dislocation. Thus making a thorough evaluation of any patient with an AC joint injury with paying attention to the SC joint is very crucial. Complications are many due to operative treatment of AC dislocations. Other than general complications such as infection and osteomyelitis that occur from the operative procedure, many specific complications occur (e.g., “a drill hole fracture, loss of purchase of the internal fixation, metal failure, and migration of the fixation device to other parts of the body”). The rate of loss of reduction is significant. The weight of the entire upper extremity is supported through a limited available area for fixation. Additionally, the potential planes of motion at the injured AC joint are many and makes loading of the reconstruction complex. So longer postoperative immobilization is advocated than is commonly described.

Migration of Pins in Acromioclavicular Joint Injuries

Pins which are used for AC joint stabilization have been reported to migrate into remote, life-threatening locations like the lung, the cord,posterior to carotid sheath, and pleura or close to it. Vessels are injured by the migrated pin in the thorax and neck by penetration (more historical at this point).

Many times prevention of pin migration can be achieved by bending a hook on the protruding part of the pin from the acromian process.

But, if the pins break, part of the pin migrates. Patients must be prepared and forewarned of the possible necessity of pin removal and the complications associated if the pin is not removed. 37 reports of pin migration in surgeries about the shoulder were reviewed by Lyons and Rockwood, and suggested to avoid pin use in this area. If pins are used, they should be bent or have devices which restrain to bring down the risk of migration. The patient should be forewarned of the risks involved. Patients should be closely followed-up and at the end of therapy or if migration occurs the pins are to be removed.

Failure of Soft Tissue Repairs in Acromioclavicular Joint Injuries

To treat ligamentous injury to the AC joint, simple repair of the CC and AC ligaments without using CC sutures, screws, or internal fixation, will fail. This is more true if the injury of the AC joint is chronic as there is often significant

displacement between clavicle and coracoid. Transferring the acromial attachment of the coracoacromial ligament onto or into the medullary canal of clavicle's distal part (the Weaver–Dunn technique) alone is not strong enough in general. Supplementation with additional fixation is recommended as in the treatment section. Suture breakage, pullout of suture anchor, or breakage of screw can cause soft tissue failure. If the failure is noted early in the postoperatively, the problem is corrected by reoperation. Infection should be suspected and ruled out when the failure occurs later i.e. weeks or months after surgery.

Recently Reported Complications with ACCR Technique

Treating highly displaced or chronic AC joint dislocations by reconstruction of the CC ligaments with allograft tendons is becoming popular in the literature, but there are complications.

Turman et al recently reported three cases of clavicle fracture after AC joint reconstruction highlights this. The report shows that the incidence of clavicle fracture happened in three of seven patients who were treated with CC ligament reconstruction:

Type V injuries occurred in all patients, two of the patients underwent acute reconstructions (<6 month after injury), while one patient was treated after 2 years of injury. The paper points out that the clavicle bone tunnel diameter being more

(all cases >5.5 mm) and the lack of AC joint ligament repair or reconstruction may be the reason for failure. There is increased force on the native or reconstructed CC ligaments if the posterior translation at the AC joint is high with no AC ligament integrity. As a second mode of possible catastrophic failure, wide bone tunnel has been reported and osseous anatomy of clavicle and the density of bone relating to fracture risk for bone tunnel position and diameter. Our current recommendation to prevent this complication is to avoid >5.5 mm tunnels, minimize the graft, tap the clavicle tunnels before interference screw insertion and ensure at least 25 mm of bone between tunnels.

Complications of Nonabsorbable Tape or Suture

When CC fixation is done using grafts or synthetic material various complications occur. Goldberg et al. described Dacron graft erosion through clavicle's distal part in their series .

Moneim and Balduini noted that there was fracture of corocoid after reconstructing the CC ligaments through two drill holes in clavicle's distal part. It is reported the usage of loop sutures between the coracoid and the distal clavicle are reasons for secondary distal clavicular fractures.Of other complications aseptic foreign body reactions and infections are a few;

"Neault et al." 110 reported three cases where there was direct relationship

between nonabsorbable tape or suture and postoperative infections. In two of the cases the infection occurred within one year, but one 5 years after repairing a type III injury." Colosimo et al." 30 reported two cases in whom after 2 and 4 years of surgery there was aseptic foreign body reaction induced by Dacron graft. Microscopically there was chronic inflammation with a foreign body giant cell reaction. Patients, both of them, improved once the Dacron material was removed and returned to work in a short time i.e. in 10 days.

Acromioclavicular Arthritis

Surgical fixation of AC joint may be followed by symptomatic arthritis. "Weaver and Dunn" suggested excision of distal clavicle and coracoacromial ligament transfer for both acute and chronic AC separations.

In a review literature, Cook and Heiner suggest excision of distal clavicle as part of the surgical management of patients with acute AC separations. Their report shows that in patients who suffered AC joint injury 24% of them had postoperative degenerative changes and there was little morbidity associated with primarily excising the distal clavicle. Conversely, primary excision of the distal clavicle is not advocated in many results of operative management of AC separations reported. So, in acute AC injuries there is no consensus between primary excision of distal clavicle and transfer of corocoacromial ligament. It is our practice to

preserve the AC joint articulation whenever possible. However, the scar formed within the dislocation space including the meniscus homologue needs to be removed to allow for reduction. If any distal clavicle is removed we attempt to remove it from the posterior edge of the clavicle as that is typically the location of abutment or impingement with the posterior edge of the acromion which may produce pain.

PART-B

PREAMBLE

A gold standard for the reconstruction of the coracoclavicular complex has yet to emerge for the treatment of separation of the acromioclavicular joint. Most of the current techniques do not recreate the original anatomy and do not use strong materials to maintain the reduction during the process of healing. There is constant deforming force exerted by the weight of the arm on the fixation construct during biologic healing. In the acute setting, after ligament rupture there is a robust healing response , and there is no need for additional grafting if the initial fixation remains stable during the process of healing. In the chronic setting, biologic graft material is needed for the fixation construct to make sure the long-term stability and function. During the healing process, graft material may become weak and there may be stretching during revascularization. So, when a fixation device is used along with a graft, there is risk for implant failure when there is deformation and stretching of the graft. Ideally a fixation construct that can restore the normal biomechanics of the ligament complex, and can maintain reduction throughout the healing process should be used. Problems with slippage of the initial reduction, as well as complications related to implant when nonanatomical and weak construct is used are predictable. This study introduces “Endobutton &mersilene tape”, modified to use in the shoulder as a technique to reconstruct complete separation of

acromioclavicular joint. The conoid portion of the coracoclavicular ligament is reproduced by placing this device in the corocoid and clavicle through holes. The “Endobutton &mersilene tape” material has both strength and stiffness more than the native anatomy, thus causing a stable reduction. It is a simple procedure associated with low morbidity and can be done arthroscopically too.

This study includes 20 patients all of whom are adults. It includes complete AC joint injury (III,IV,V)

Based on our findings , we here by submit

Prospective Analysis of Functional Outcome of Complete Acromioclavicular joint Dislocation Repair Using Double Endobutton Technique

AIM OF STUDY

Our study introduces a operative technique for coracoclavicular ligaments reconstruction using " double endobuttons , mersilene tape and #5 Ethibond suture" that provides anatomical reconstruction.

The aim of this study is to analyze:

1. The functional outcome of Double endobutton& mersilene tape reconstructions done for complete Acromioclavicular joint disruptions operated in Tirunelveli Medical College Hospital.
2. To assess the need for repairing the "acromioclavicular capsule, ligaments and coracoclavicular ligament" .
3. To assess the reduction and AC joint stability.
4. To identify complications related with this procedure.
5. To assess the functional status using DASH SCORE, CONSTANT SCORE.

MATERIALS AND METHODS

This is a prospective study conducted in Tirunelveli Medical College Hospital during the period between july 2014 to September 2015 of 20 cases of complete Acromioclavicular Joint injuries(Rockwood type III-V) treated by reconstruction of coracoclavicular ligaments using Double Endobutton & Mersilene tape, # 5 Ethibond.

INCLUSION CRITERIA

1. Complete acromioclavicular joint disruptions (Rockwood and Young type III-VI)

2. Acute injuries

3. Age group included are 18-60 years

4. Closed injuries

EXCLUSION CRITERIA

1. Chronic injuries

2. Elderly patients

3. Compound injuries

METHODS

1. All cases were operated in our hospital.

2. Minimum of 6 months of post-operative follow up

3. Specified postoperative protocol was followed for all patients.

4. Outcome was measured based on DASH questionnaire and Constant score at intervals of 6, 12, 24 weeks .

5. Radiological assessment was done at intervals of 6, 12, 24 weeks

The time protocol extends from within 24 hours of injury to 7 days of injury.

The cases were analysed as per the following criteria

AGE DISTRIBUTION

SEX DISTRIBUTION

SIDE OF INJURY

MODE OF INJURY

CLASSIFICATION OF INJURY

TIME INTERVAL BETWEEN INJURY AND SURGERY

ASSOCIATED INJURIES

DURATION OF POSTOPERATIVE STAY

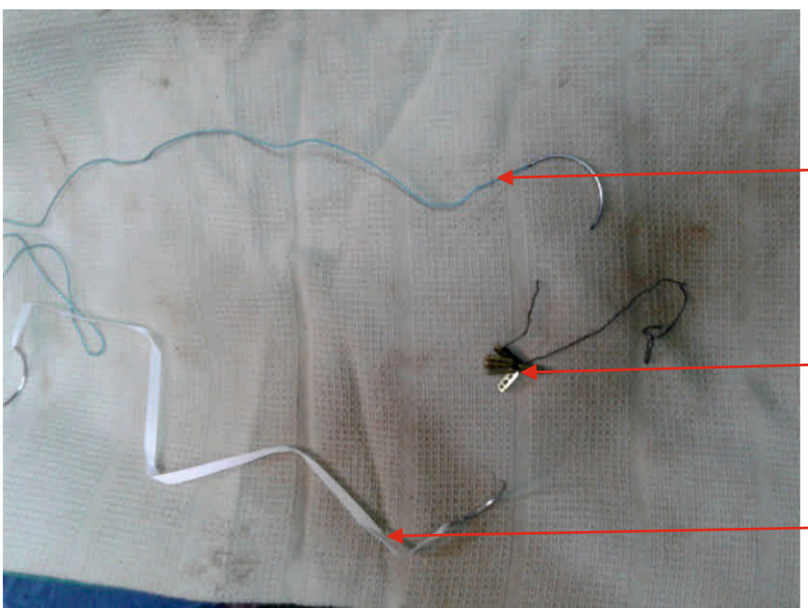
XRAY EVALUATION -6 WEEKS, 10 WEEKS, 14 WEEKS

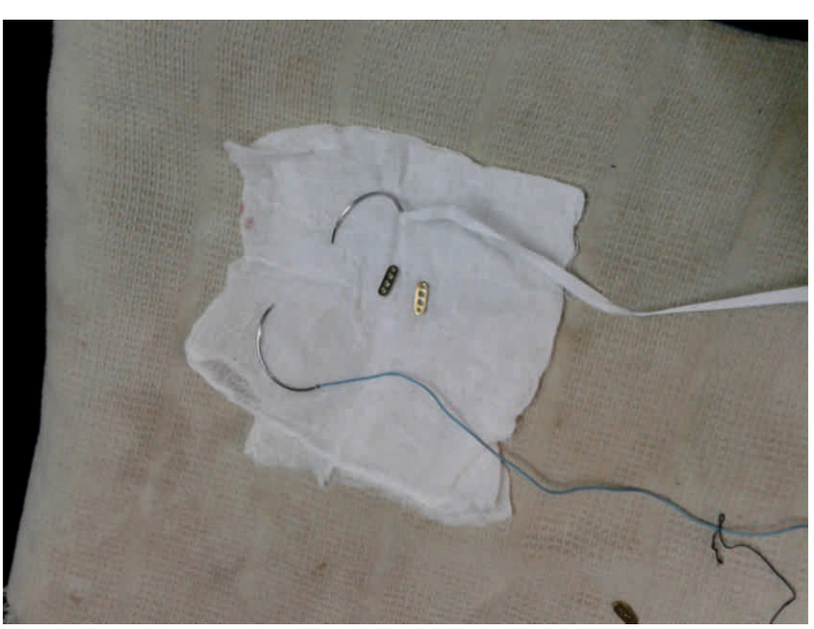
RANGE OF MOVEMENTS

FUNCTIONAL OUTCOME USING DASH SCORE, CONSTANT SCORE

POSTOPERATIVE COMPLICATIONS

IMPLANTS





PROCEDURE AND POSTOPERATIVE PROTOCOL

GENERAL MEASURES

All patients received in the emergency ward were evaluated for any associated major injuries like chest injury, brachial plexus injury. Then x-ray of involved shoulder AP, Zanca view and x-ray of both shoulder standing STRESS AP view were taken. Patient was immobilized with arm sling.

All cases were taken up for surgery before 7th day.

SURGICAL TECHNIQUE

The base of the coracoid tip is palpated and an incision 2 inch above it is made extending to the anterior edge of the distal clavicle. Flaps are raised medially and laterally. Along the fibres of deltoid it is split, and coracoid is identified and cleared up to the base. At the corocoid base the medial and lateral edges are made out clearly. Articular disc of AC JOINT was debrided to allow for good reduction. Manual reduction of clavicle is done and the reduction is held while from the top of the clavicle about 3 cm medially to the AC joint and midway between the anterior border and posterior border of the clavicle,drill tip guide wire is introduced. The drill hole should be positioned directly over the base of the coracoid, and the drill should be directed a little anteriorly. When the guide wire is

drilled through the clavicle, the guide wire is easily viewed in between the clavicle and coracoid.

The tip of the guide wire is drilled throughout the base after the confirmation of its position in the centre, between the medial and lateral edges. The 4.5-mm " cannulated drill" is reamed over the drill tip guide wire the clavicle well reduced, the channel length is determined using "Endobutton depth gauge".

Another 2.5-mm drill hole is made 1 cm lateral to the Endobutton drill hole. Through first and fourth holes of the Endobutton " #5 Ethibond" inserted& Mersilene tape inserted into second &third holes of Endobutton" . Endobutton, with its sutures, is pushed to the top of the clavicle through holes drilled using a 3.2-mm "smooth cylindrical plunger". The Endobutton is seen in the space between clavicle and coracoid which is pushed into the coracoid drill hole until it protrudes out of the underside of coracoid. One end of mersilene tape is pulled up, to lock the Endobutton to the underside of the coracoid. Of the 2 pairs of Ethibond tails, one is pulled out the interval between coracoid and clavicle. This will leave 1 suture with 2 tails going through the coracoid Endobutton and exiting the top of the clavicle. Firm downward pressure is applied on the clavicle to maintain the best reduction. With very firm pull upward on mersilene tape, in Another endobutton , free ends of mersilene tape passed into 2nd &3rdnd hole and ethibond into 1st & 4th holes.

The sutures are tied on top of the Endobutton . This locks the endobutton in place and reconstruction of conoid of coracoclavicular ligament is complete. The sutures in the coracoclavicular space are retrieved and 1 tail is passed through the second (2.5-mm) drill hole. The suture is tied. Thus the trapezoid portion of the coracoclavicular ligament is recreated. In all our cases the coracoclavicular ligaments could not be repaired due to difficulty in identifying the ligament, friability of tissue.

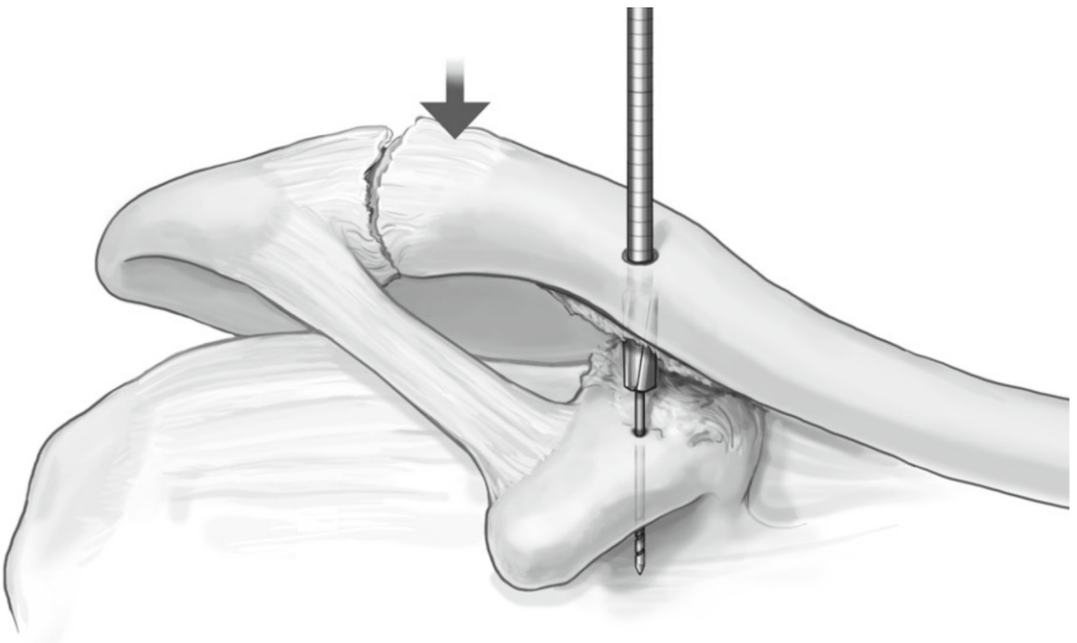
POSTOPERATIVE PROTOCOL

The surgical procedure described above took about 60 minutes for completion. Pendulum exercises were started on the 2nd post operative date and passive mobilization started as patient tolerated. Within 3 weeks active exercises were started and full range of movement was started after 3 weeks.

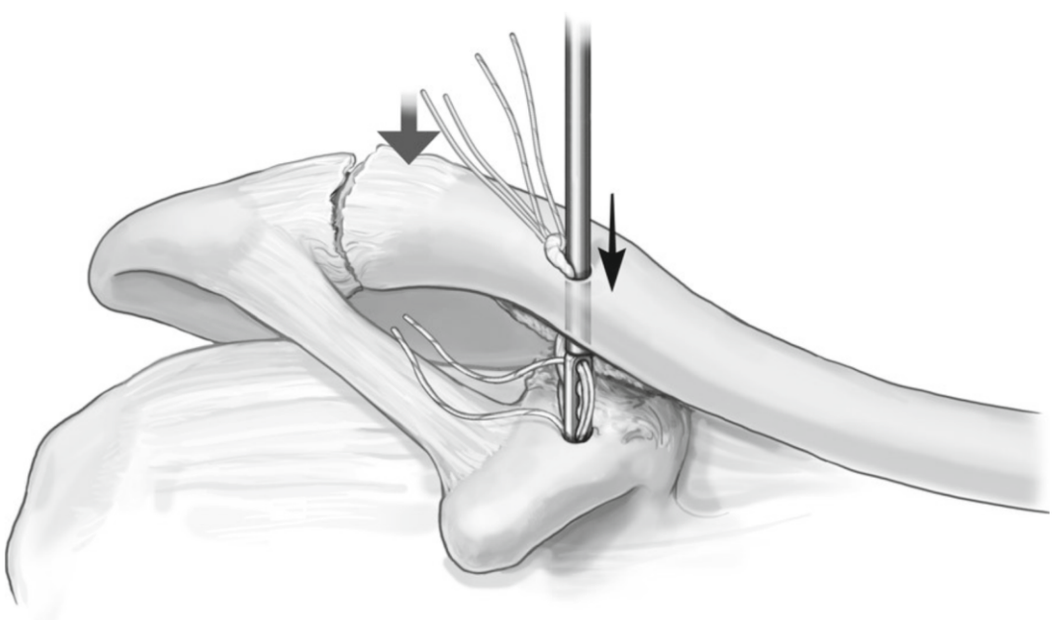
We have used the DASH questionnaire, Quick DASH score and Constant score as they reflect the subjective and objective perspective of the shoulder function. The range of movement as required in the Constant score was measured with a goniometer.

The DASH and quick DASH scores range from 0-100 where zero is the best score and indicates excellent results. Similarly score of 100 indicates poor result. For the constant score, a top score of 100 indicates highest and excellent results while zero indicates least score and poor result. The forms were filled at each visit and at which time they were evaluated for signs of implant failure, irritation, impingement or infection. X-rays were taken preoperative, immediate postoperative and subsequently at 6 week and 6 months. Placement of endobutton, reduction of AC joint , CC calcification were assessed at serial intervals.

SURGICAL TECHNIQUE

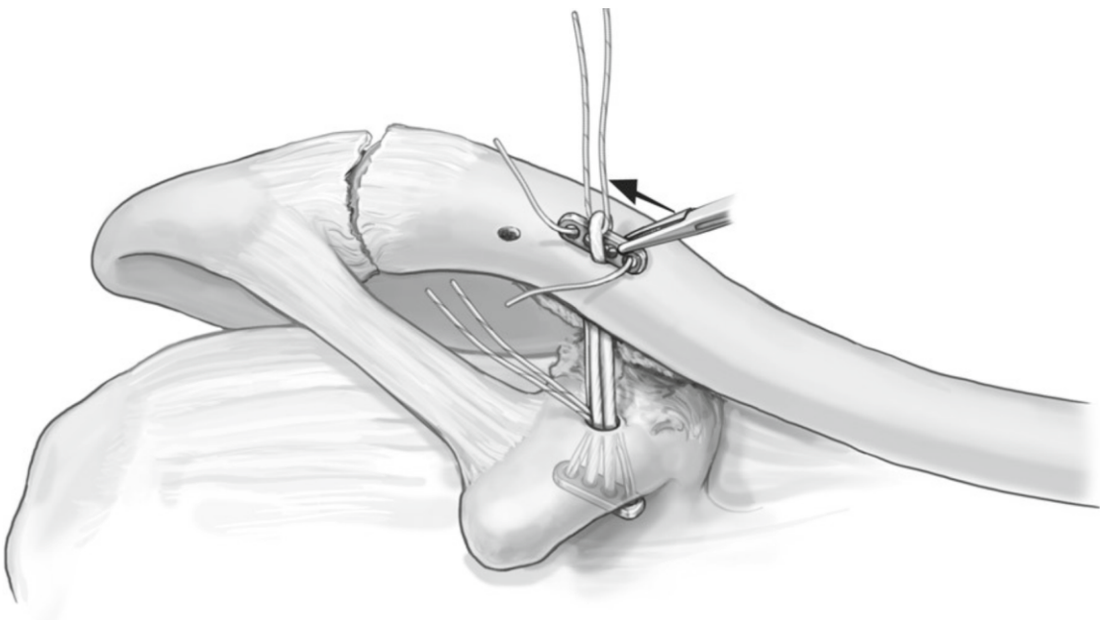


Passing of cannulated drill bit over the guide wire

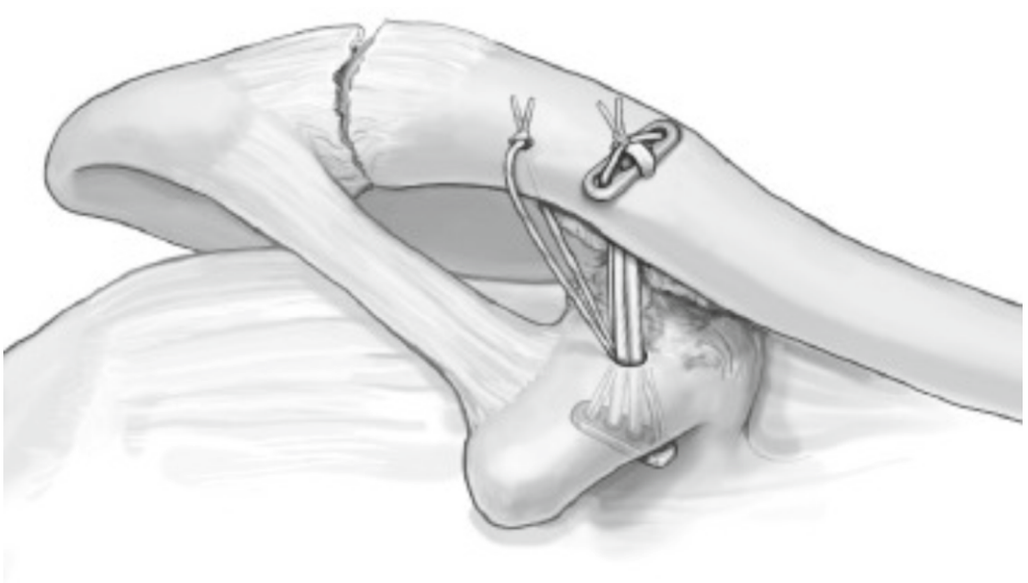


Anchoring the Ethibond and Mersilene tape through the hole

SURGICAL TECHNIQUE

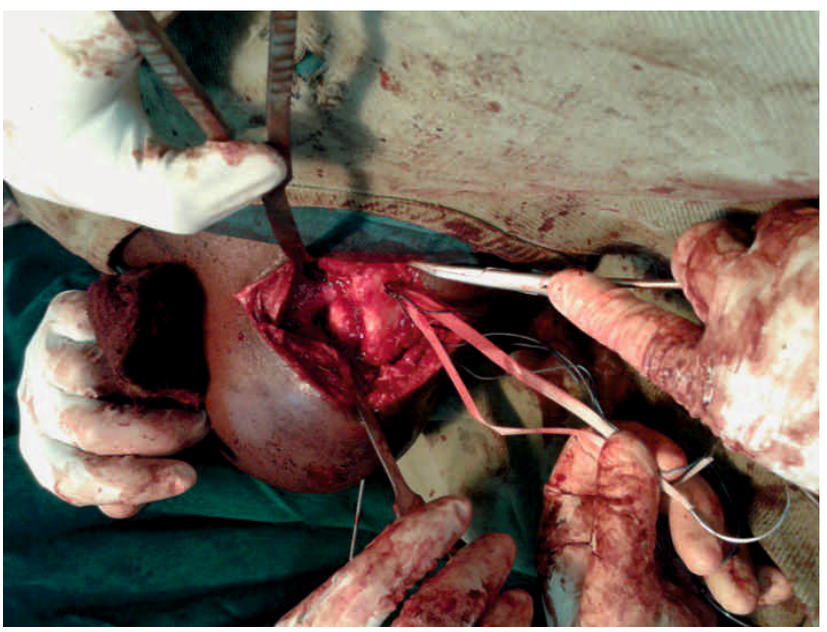


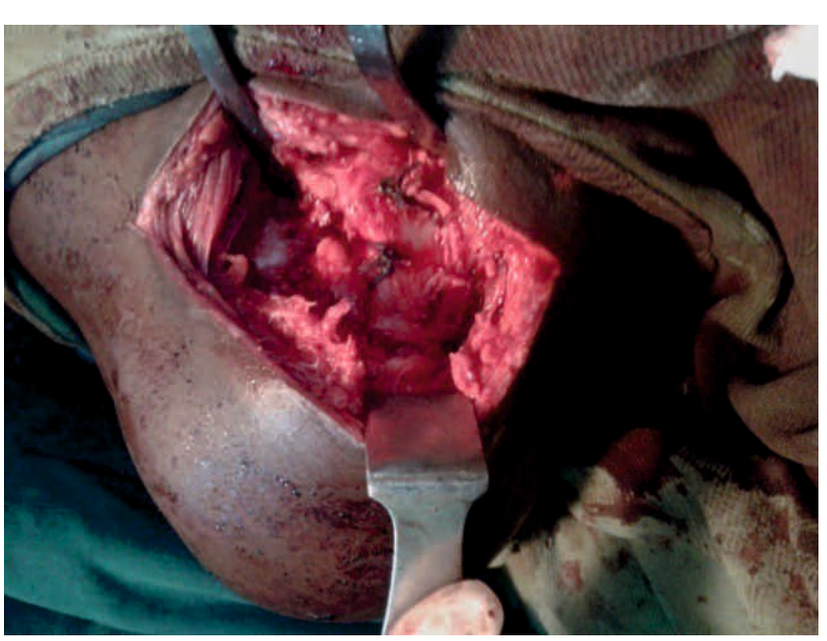
Tensioning of the suture anchors to achieve reduction of the joint



Final fixation with the second endobutton and repair of trapezoid ligament

INTRAOPERATIVE PICTURES





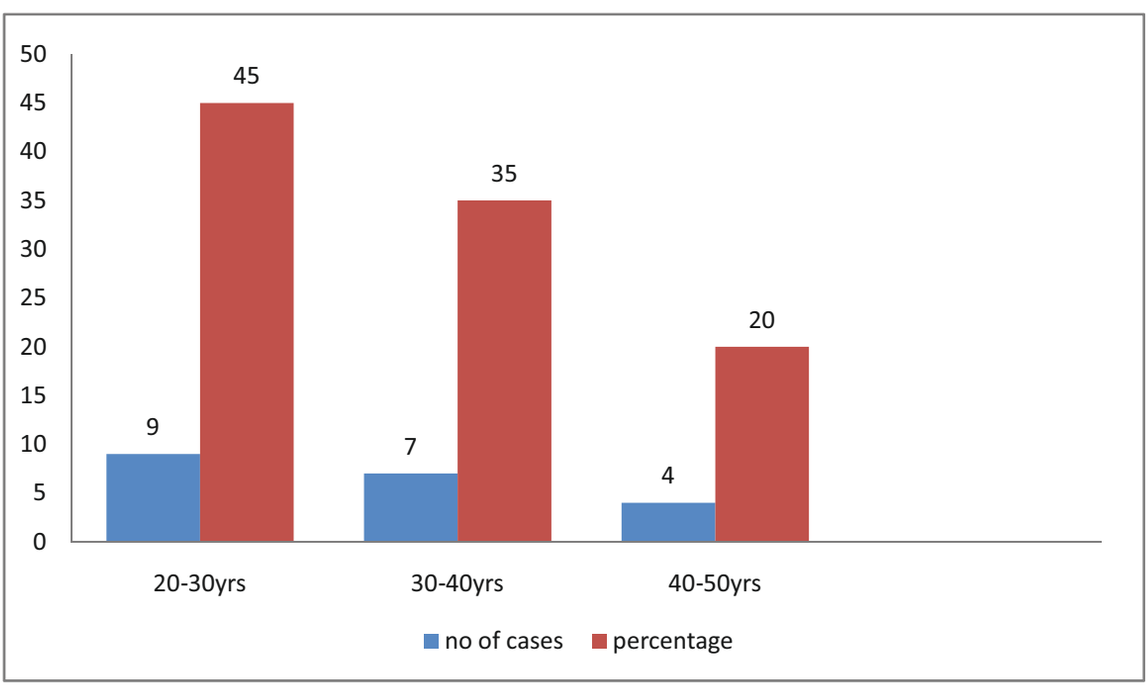
INTRAOPERATIVE PICTURES

OBSERVATIONS

This study comprised of 20 patients were admitted in the department of Orthopaedics Tirunelveli Medical College Hospital. The following are the observations and the results compiled at the end of study.

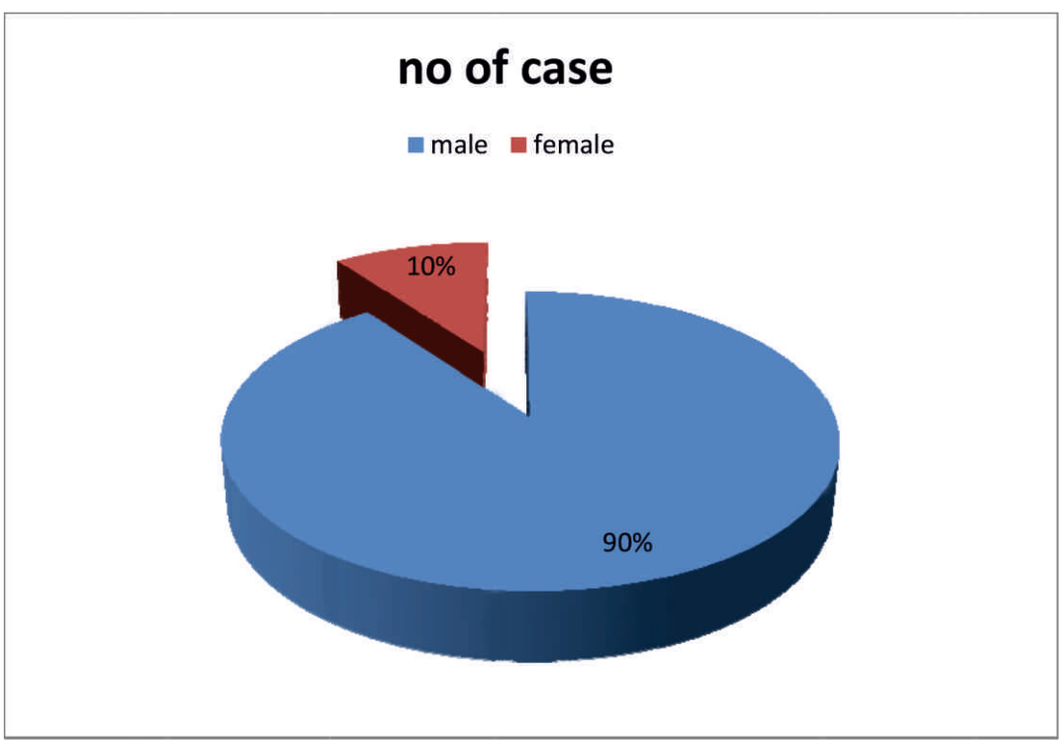
AGE WISE DISTRIBUTION (n=20)

S.No	Age Group	No of cases	Percentage(%)
1	20-30 yrs	9	45
2	30-40yrs	7	35
3	40-50yrs	4	8



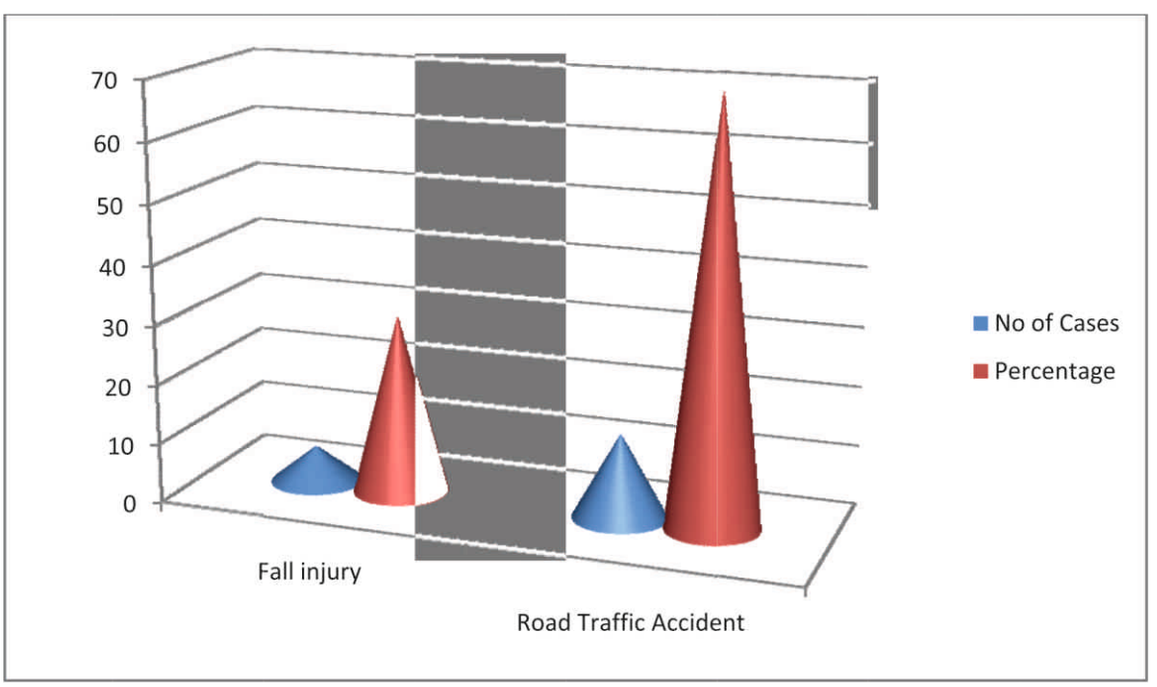
SEX WISE DISTRIBUTION (n=20)

S.NO	SEX	No. of Cases	Percentage
1	Male	18	90
2	Female	2	10



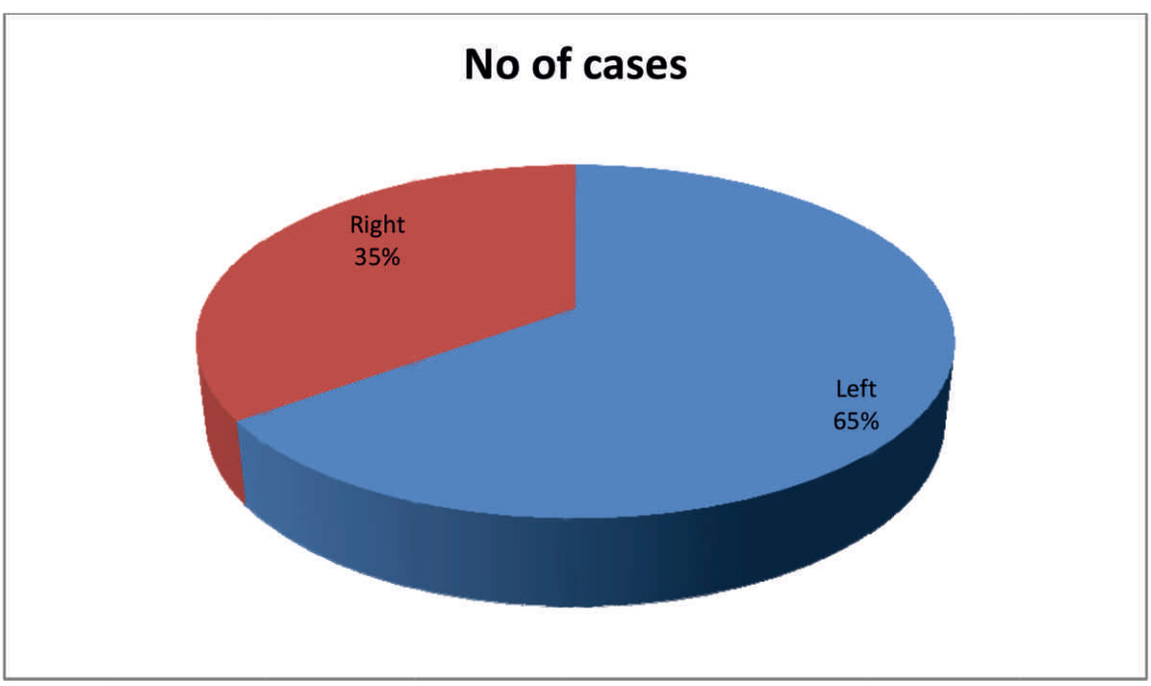
DISTRIBUTION ACCORDING TO MODE OF INJURY (n=20)

S.No	Type of Injury	No. of Cases	Percentage
1	Fall Injury	6	30
2	Road Traffic Accidents	14	70



DISTRIBUTION ACCORDING TO THE SIDE (n=20)

S.No	Side	No. of Cases	Percentage (%)
1	Left	13	65
2	Right	7	35

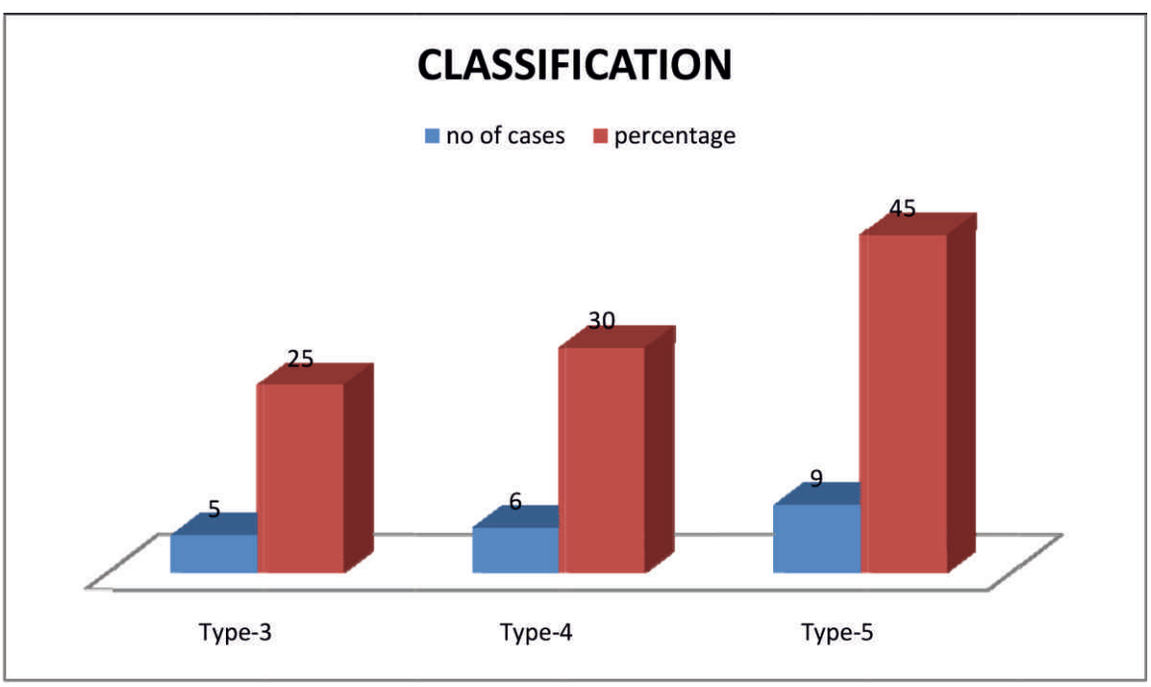


TYPE OF FRACTURES

CLOSED (n=20)

CLASSIFICATION

Type	No of cases	Percentage(%)
Type- 3	5	25
Type -4	6	30
Type -5	9	45

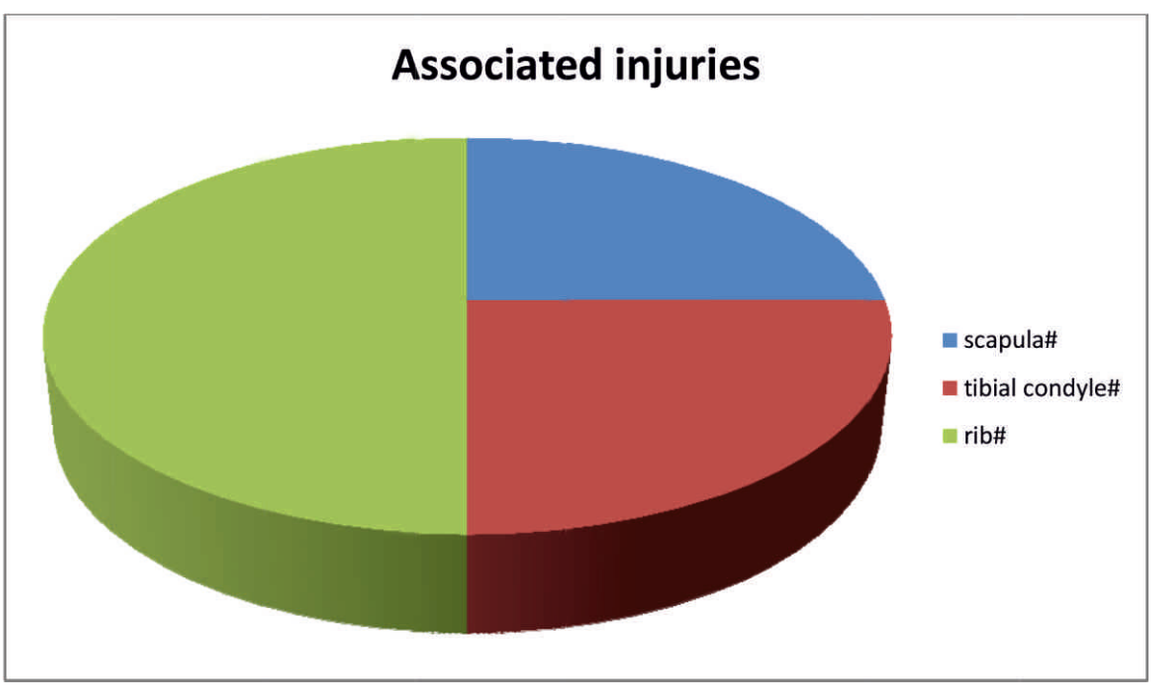


ASSOCIATED INJURIES

Scapula neck# - 1 case

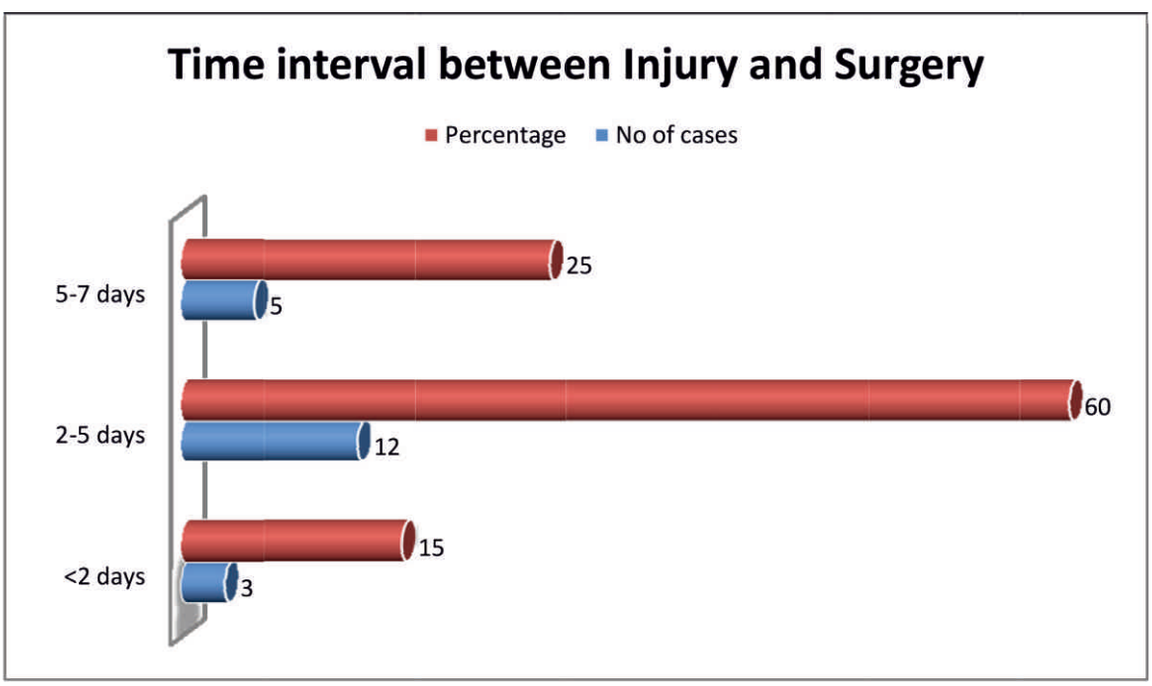
Tibial Condyle#- 1 case

Rib# - 2 case



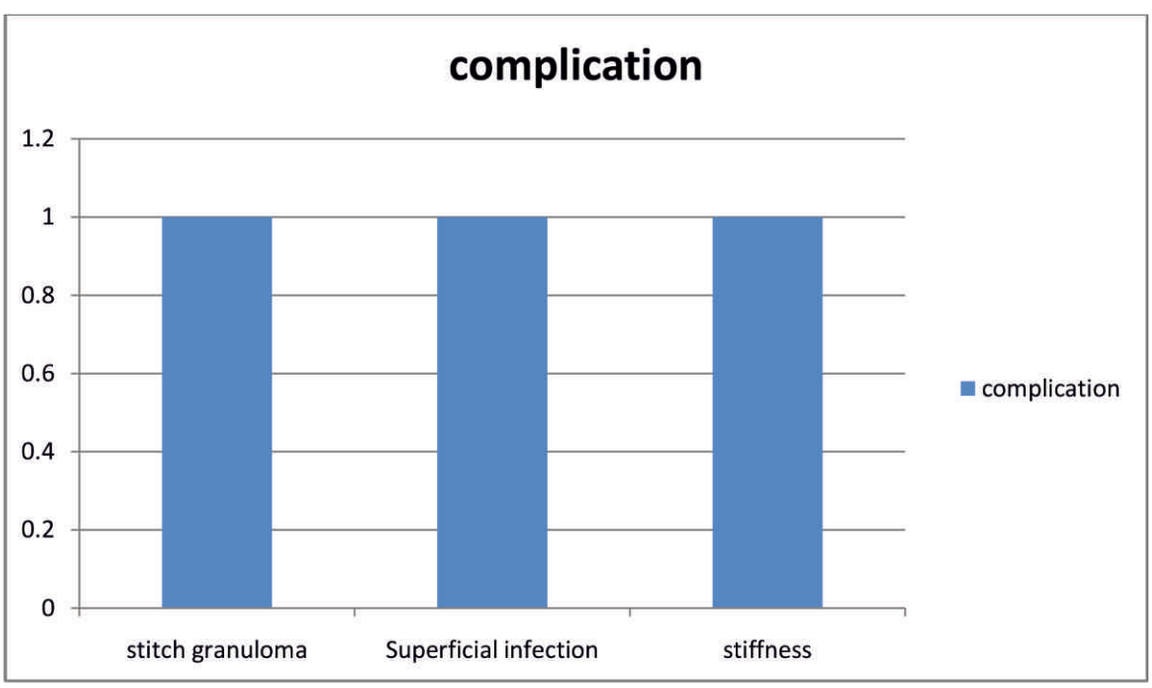
TIME INTERVAL BETWEEN INJURY AND SURGERY

Time Interval	No of Cases	Percentage(%)
< 2 days	3	15
2-5 days	12	60
5-7 days	5	25

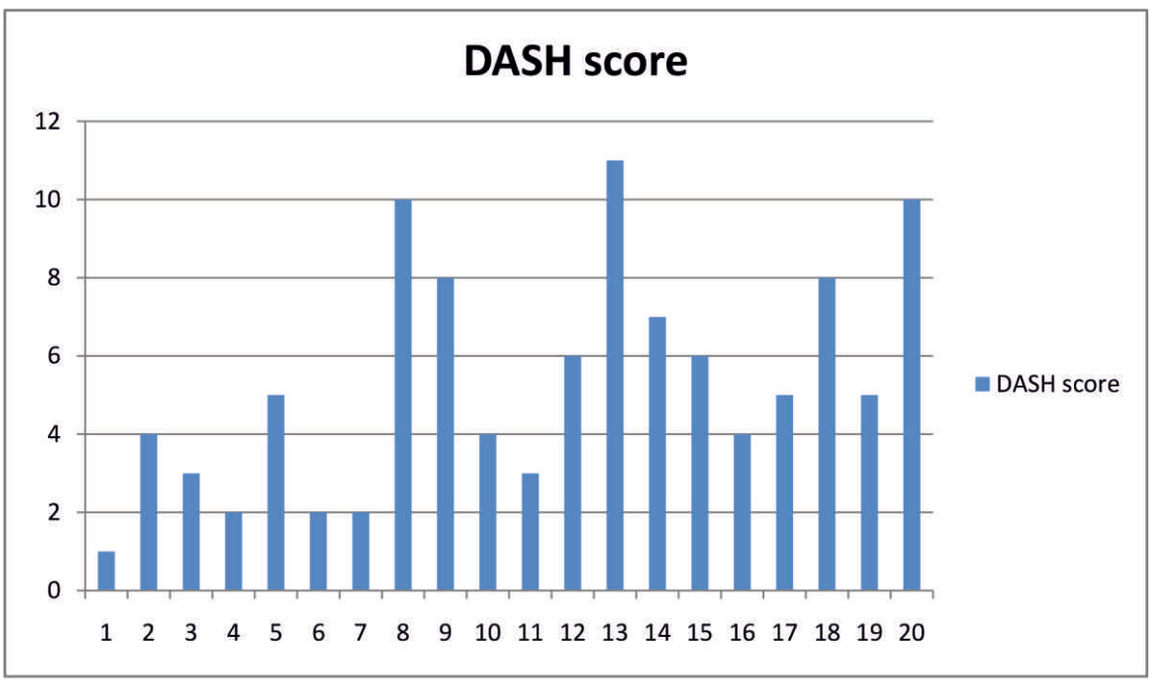


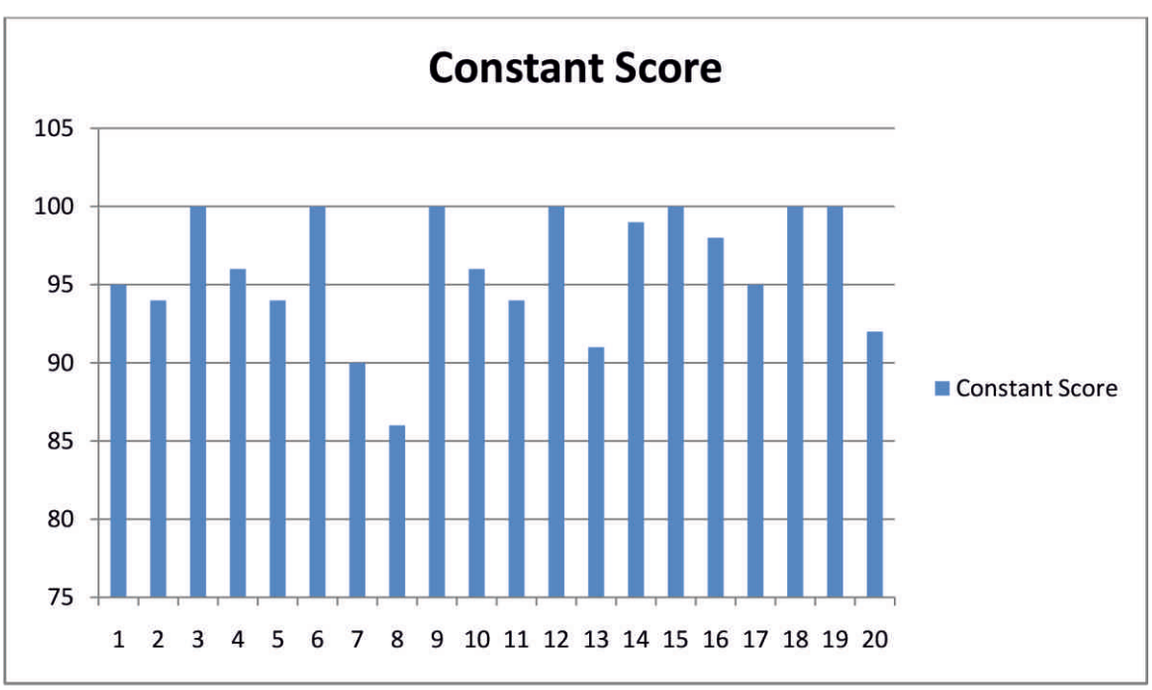
COMPLICATIONS

Stitch Granuloma	1
Superficial infection	1
Stiffness of Shoulder	1



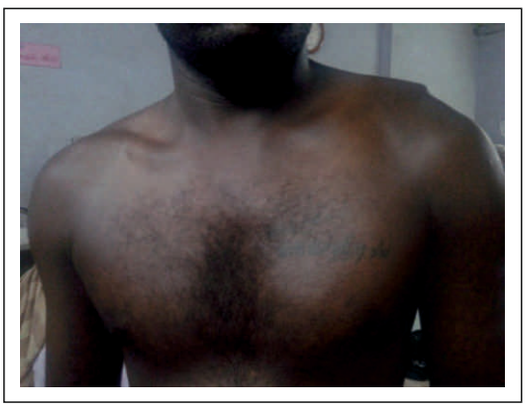
FUNCTIONAL OUTCOME

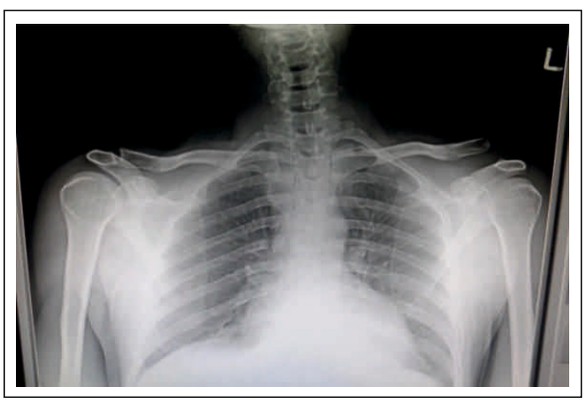


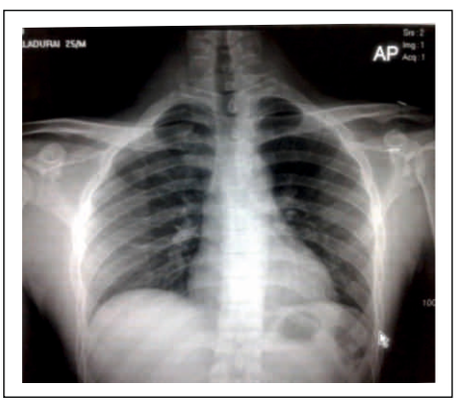


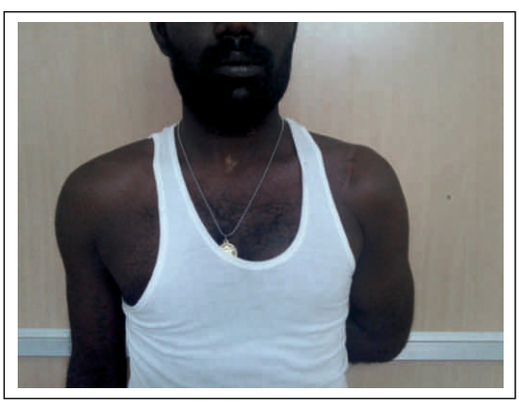
POST-OPERATIVE PICTURES

CASE - I





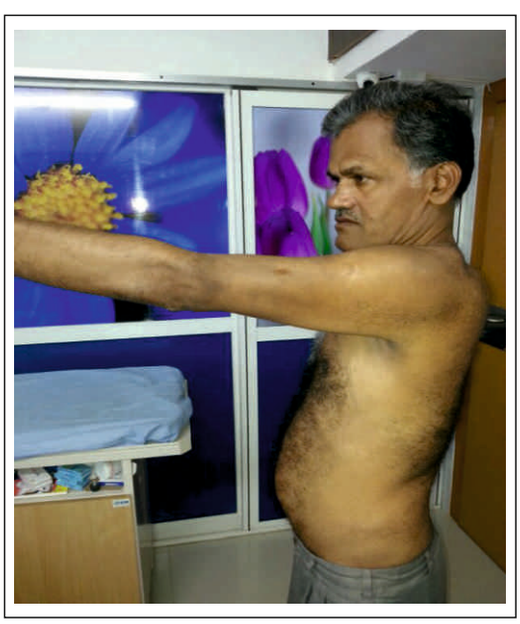




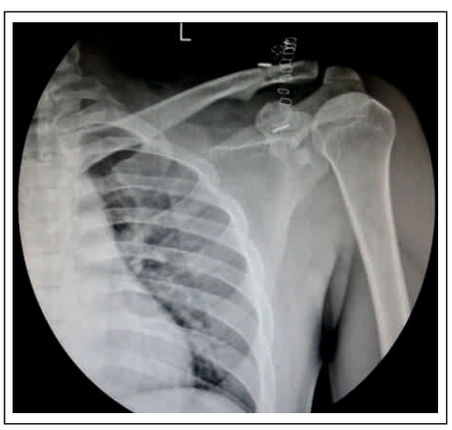
CASE - II

CASE - III

CASE - IV



CASE - V



DISCUSSION

Surgical treatment for AcromioClavicular joint injuries has much higher success rates in recent studies, many studies have demonstrated successful outcome even with non operative treatment . There were problems with hardware failure like Bosworth screw, hook plate and so there will be need for a second procedure to remove the hardware.

There are various attempts to improve the original Weaver-Dunn technique to stabilize the AC joint by using nonmetallic fixation. But there was implant-related problems including infection, soft tissue reactivity, and fractures have been observed although many of these modifications have shown excellent success. So the development of purely biologic constructs with the use of allograft or autograft to reconstruct the coracoclavicular complex arised due to these implant-related problems .

Biomechanical studies reveals that to recreate the native anatomy and finding materials that can tolerate the cyclic loading without deformation or failure the ultimate strength, stiffness, and load elongation curves of the native complex have been measured against various repair constructs. Testing has been done with both simple load to failure modes as well as response to cyclical loading to simulate postoperative conditions.

Traditional procedures such as the Weaver-Dunn have been shown to be much weaker and much more compliant than the native ligament leading, thereby explaining the frequently observed high failure rate of this procedure. Numerous modifications of the original Weaver-Dunn procedure have been evaluated with biomechanical studies. The most common modification involves stabilizing the joint by placing a cerclage material around the base of the coracoid and through a hole in the clavicle. Thick, robust materials such as polydioxanone bands or large tendon grafts have indeed shown comparable strength relative to the native complex, however, their load-elongation curves indicate lower stiffness in most of the tested materials.

More importantly, non anatomical techniques like cerclage fixation method drags the distal clavicle anteriorly. A study by Baker et al shows that " even when the drill hole is placed within 2 mm of the anterior edge of the clavicle", the clavicle is draged anteriorly. During the healing process, when the constant cyclical forces act on it, this malreduction likely lead to weakening of the construct and there is osteolysis of clavicle at the level of circlage.

Fixation placed in anatomically correct positions may improve implant stability and response to cyclical loads. Indeed, several newer techniques have been described that anatomically placed holes in the clavicle & coracoid followed by placing grafts or fixation devices to achieve stability.

The Endobutton &mersilene device reproduce the course of the conoid portion of the coracoclavicular ligament which is placed in an anatomically correct fashion. By approximately 40% (internal testing by Smith and Nephew) the strength and stiffness of the device exceed the native ligament complex. **Only surface of the 2 metal Endobutton bear the deforming forces of the weight of the arm , not the suture material itself, thereby suture material has less chance of soft tissue reaction. 5# Ethibond that passes through the Endobutton holes used to recreate the course of the trapezoid component of the coracoclavicular ligament, thereby additional horizontal plane stability**.

In addition, the drill holes which are made relatively small (4 mm), allowing the implant to be used either as conjunction with other biologic implants or a stand-alone device to improve long-term stability. With minimal soft tissue dissection, the technique uses a small incision and is technically straightforward .

The aim of the study is to evaluate the functional outcome of the complete acromioclavicular injuries treated with double endobutton , mersilene tape and ethibond # 5

We have done 20 cases of complete AC joint injuries during the period of july 2014 – September 2015.

We had 9 cases of Rockwood type 5, 6 cases of type 4, 5 cases of type 3.

We had 18 male cases , 2 female cases.

All 20 cases were closed injuries. Most common mode of injury is RTA. We had 6 right sided cases and 14 left sided cases. Most common associated injury is chest injury.

The youngest patient in our study is 21 years and oldest is 45 years.

All cases were evaluated with x-ray shoulder zanca view and x-ray both shoulder AP stress view, Routine blood investigation and ECG was done . Preoperative antibiotics given.

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All injuries opened with vertical strap incision followed by reduction of AC joint and reconstruction done with double endobutton & mersiline tape.

Average operating time was 60 minutes. Final fixatioin was checked under c-arm. Duration of postoperative stay is 8-10 days and all cases are started with pendulum exercises on the first postoperative day.

Postop x-ray were taken. Postop outcome of reconstruction is measured by DASH Score , Constant score. Active full shoulder movements, active range of movements were started on 4 weeks.

Post operative complications was stitch granuloma – 1 case, Shoulder stiffness-1case, superficial infection-1 case. DASH, Quick DASH and Constant score is used for assessing functional outcome .

At the last follow-up, 18 patients had an excellent outcome as assessed by Constant score, DASH and Quick DASH scores.

One patients had good outcome . one patient had fair outcome.

The mean scores at the last follow-up were:

Constant score was 96 (range 80 -100),

DASH score was 5.3 (range 1-11)

No vascular or neurological complications were noted. None of them had any functional deficits.

Constant score is obtained from subjective and objective scoring including pain, activities of daily living, range of movement and muscle power. Excellent score is 100 and zero indicating poor score.

DASH questionnaire has 30 questions to be answered by the patient relating to activities of daily living, pain and confidence. Poorest outcome is 100 while the best outcome is a score of zero.

Quick DASH is an abbreviated version of DASH and contains only 11 questions out of the 30 in DASH. The quick DASH is statistically equal to DASH score.

In our study outcome of reconstruction is studied extensively from operation table to full functional outcome till 6 months of followup.

CONCLUSION

In the present study of assessing the functional outcome of complete AC joint injuries we reached the following conclusion.

1. AC joint reconstruction by Endobutton and Mersilene tape results in early functional recovery and full range of shoulder movements.
2. Endobutton avoids the implant related complications and further surgery to remove the implant
3. In our series double Endobutton and Mersilene tape has good results of functional outcome and pain free shoulder movements.
4. Intraoperative and post operative complications are minimal in our case series.
5. Endobutton , mersilene tape and # 5 Ethibond gives both vertical &horizontal stability of Acromioclavicular joint.
6. At present we have only one year follow up. Since we have not repaired the Coracoclavicular ligaments , in this short term followup Endobutton provides Excellent outcome and long term results are awaited.

SHOULDER PAIN EVALUATION CONSTANT SCORE

James T. Mazzara, MD | Shoulder and Elbow Surgery | Sports Medicine | Occupational Orthopedics

Name_____ Date_____ Age_____ Insurance_____

Handedness: R L B Side: R L

Operation / Diagnosis_____

Examination: Pre-op 3 Months 6 Months 1 Year 2 years ___years

Pain (15 Points): (Average of 1+2) **A**

1. Do you have pain in your shoulder during normal activities?
   No=15 Mild=10 Moderate=5 Severe or permanent=0
2. If "0" means no pain and "15" is the maximum pain you can experience, please circle the level of pain you experience in you shoulder in general.

Level of Pain	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Points	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Activities of Daily Living (20 points): Total (1+2+3+4) **B**

1. Is your occupation or daily living limited by your shoulder?
   No=4 Moderate limitation=2 Severe limitation=0
2. Are your leisure and recreational activities limited by your shoulder?
   No=4 Moderate limitation=2 Severe limitation=0
3. Is your night sleep disturbed by your shoulder?
   No=4 Moderate limitation=2 Severe limitation=0
4. State to what level you can use your arm for painless work-related or daily activities.
   Waist=2 Xiphoid (sternum)=4 Neck=6 Head=8 Above head=10

Range of Motion (leave this to the doctor or physical therapist)/**(40 points): Total (1+2+3+4)** **C**

1. Forward flexion		**2. Abduction**		**3. External Rotation**		**4. Internal Rotation**	
0-30	0	0-30	0	Hand behind head & elbow forward	2	Dorsum of hand to….	
31-60	2	31-60	2	Hand behind head & elbow back	4	Lateral thigh	0
61-90	4	61-90	4	Hand above head & elbow forward	6	Buttock	2
91-120	6	91-120	6	Hand above head & elbow back	8	LS junction	4
121-150	8	121-150	8	Full elevation of arm	10	Waist (L3)	6
>150	10	>150	10			T12	8
						Interscapular area T7	10

Strength of Abduction (25 points): Average (kg) (To 90 degrees abduction or highest level patient can achieve)

Trial 1 _____ Trail 2_____ Trial 3_____ Average _____ **D**

Total Constant Score: **A+B+C+D**

36 Haynes Street Manchester, CT 06040 860-646-0188 *www.OrthoOnTheWeb.com*
Hartford Hospital Health Care Center @ 1260 Silas Deane Hwy. Wethersfield, CT 06109

QUICKDASH

PatientName:_____DateofBirth: _____Today'sDate:_____

Pleaserateyourabilitytodothefollowingactivitiesinthelastweekbycirclingthenumberbelowthe appropriateresponse.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE TODO
1. Openatightornewjar.	1	2	3	4	5
2. Doheavyhouseholdchores(i.e.,washwalls,floors).	1	2	3	4	5
3. Carryashoppingbagorbriefcase.	1	2	3	4	5
4. Washyourback.	1	2	3	4	5
5. Useaknifetocutfood.	1	2	3	4	5
6. Recreationalactivitiesinwhichyoutakesomeforceor impactthroughyourarm,shoulderorhand(i.e.,golf, hammering,tennisetc.)	1	2	3	4	5

	NOTATALL	SLIGHTLY	MODERATEL	QUITEABIT	EXTREMELY
7. Duringthepastweek,towhatextenth asyourarm, shoulderorhandprobleminterferedwithyournormal socialactivitieswithfamily,friends,neighborsorgroups?	1	2	3	4	5

	NOTLIMITED ATALL	SLIGHTLY LIMITED	MODERATEL LIMITED	VERY LIMITED	UNABLETO DO
8. Duringthepastweek,wereyoul imitedinyourworkor otherregulardailyactivitiesasaresultofyourarm, shoulderorhandproblem?	1	2	3	4	5

Pleaseratetheseverityofthefollowingsymptomsinthelastweek(circlenumber).

	NONE	MILD	MODERATE	SEVERE	EXTREME
9. Arm,shoulderorhandpain.	1	2	3	4	5
10. Tingling(pinsandneedles)inyourarm,shoulderorhand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SOMUCHIT PREVENTS SLEEP
11. Duringthepastweek,howmuchdifficultyhaveyouhad sleepingbecauseofthepaininyourarm,shoulderorhand (circleone)?	1	2	3	4	5

Sincethebeginningoftherapymyconditionhasimproved:

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Duringthepast24hours,mymaximumpainratingwas:

0 1 2 3 4 5 6 7 8 9 10

ThissectiontobecompletedbyyourPhysicalTherapist/Provider
AQuickDASHscoremaynotbecalculatedifthereisgreaterthan1missingitem.

QUICKDASHDISABILITYSYMPTOMSCORE

$$\frac{(\text{sum of n response})}{n} - 1 \times 25$$

Disabilities of the Arm,S houlder and Hand

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Write.	1	2	3	4	5
3. Turn a key.	1	2	3	4	5
4. Prepare a meal.	1	2	3	4	5
5. Push open a heavy door.	1	2	3	4	5
6. Place an object on a shelf above your head.	1	2	3	4	5
7. Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8. Garden or do yard work.	1	2	3	4	5
9. Make a bed.	1	2	3	4	5
10. Carrya shopping bag or briefcase.	1	2	3	4	5
11. Carry a heavy object (over 10 lbs).	1	2	3	4	5
12. Change a lightbulb overhead.	1	2	3	4	5
13. Wash or blow dry your hair.	1	2	3	4	5
14. Wash your back.	1	2	3	4	5
15. Put on a pullover sweater.	1	2	3	4	5
16. Use a knife to cut food.	1	2	3	4	5
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19. Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20. Manage transportation needs (getting from one place to another).	1	2	3	4	5
21. Sexual activities.	1	2	3	4	5

DISABILITIES OF THE ARM,S HOULDER AND HAND

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
22. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups? *(circle number)*	1	2	3	4	5

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
23. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? *(circle number)*	1	2	3	4	5

Please rate the severity of the following symptoms in the last week. *(circle number)*

	NONE	MILD	MODERATE	SEVERE	EXTREME
24. Arm, shoulder or hand pain.	1	2	3	4	5
25. Arm, shoulder or hand pain when you performed any specific activity.	1	2	3	4	5
26. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5
27. Weakness in your arm, shoulder or hand.	1	2	3	4	5
28. Stiffness in your arm, shoulder or hand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. *(circle number)*	1	2	3	4	5

DASH DISABILITY/SYMPTOM SCORE = $\left[\left(\frac{\text{sum of n responses}}{n}\right) - 1\right] \times 25$, where n is equal to the number of completed responses.

A DASH score may <u>not</u> be calculated if there are greater than 3 missing items.

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MASTER CHART

S.no	Name	Age/sex	Classification	Mode of injury	Side	Associated injuries	Interval b/w injury & sx	Complications	Dash score	Constant score
1.	Chelladurai	26/m	Type 4	RTA	Left	nil	2 days	nil	1	95
2.	Dhanalaxmi	25/f	Type 4	fall	Right	Nil	2 days	nil	4	94
3.	Raja	45/m	Type 3	fall	Right	Nil	5 days	Stitch granuloma	3	100
4.	Murugan	36/m	Type 5	RTA	Right	Scapula neck #	4 days	nil	2	96
5.	Muthu	44/m	Type 3	fall	Left	Nil	7 days	Superficial infection	5	94
6.	Selvan	30/m	Type 4	RTA	Left	Nil	5 days	Nil	2	100
7.	Raju	24/m	Type 5	RTA	Left	Nil	3 days	Nil	2	90
8.	Madasamy	41/m	Type 5	RTA	Left	Nil	6 days	Shoulder stiffness	10	86
9.	Karupasamy	40/m	Type 3	Fall	Right	Chest injury	7 days	Nil	8	100
10.	Kumar	20/m	Type 4	RTA	Right	Nil	3 days	Nil	4	96

11.	Moideen	22/m	Type 5	RTA	Left	Nil	2 days	Nil	3	94
12.	Krishnan	25/m	Type 4	RTA	Left	Nil	4 days	Nil	6	100
13.	Murugesan	36/m	Type 5	RTA	Left	Rib #	7 days	nil	11	91
14.	Essakimuthu	35/f	Type 4	RTA	Right	Tibial condyle #	6 days	Nil	7	99
15.	Ravikumar	27/m	Type 5	RTA	Left	Nil	3 days	Nil	6	100
16.	Murugan	32/m	Type 3	Fall	Left	Nil	3 days	Nil	4	98
17.	Venkatesh	33/m	Type 5	RTA	Left	Nil	3 days	Nil	5	95
18.	Mohamed ali	29/m	Type 3	Fall	Right	Nil	5 days	Nil	8	100
19.	Raja	21/m	Type 5	RTA	Left	Nil	3 days	Nil	5	100
20.	Alex	37/m	Type 5	RTA	Left	nil	3 days	Nil	10	92